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THE PLAY'S THE THING:
AN EXAMINATION OF PLAY'S ROLE
IN THE COGNITIVE DEVELOPMENT
OF ADOLESCENTS

A dissertation submitted in partial fulfillment of the requirements
for the degree of Doctor of Philosophy at Virginia Commonwealth University

by
Ian Scheu
B.A., Hampden-Sydney College, 2000
M.Ed., University of Virginia, 2002

Dissertation Director:
Yaoying Xu, Ph.D.
Associate Professor, Special Education and Disability Policy
School of Education

Virginia Commonwealth University
Richmond, Virginia
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Dedication

For Professor Susan Robbins, who taught me how to keep that one good sentence and throw the rest away.

Acknowledgements

*Gratias agamus Domino Deo nostro.
Dignum et iustum est.*

I would like to give my professional thanks to all of those who helped me in the Herculean task of completing my dissertation. My thanks and gratitude to my entire committee, Yaoying Xu, Jessica Hearn, Colleen Thoma, Charol Shakeshaft, and Christopher Chin. Thank you for all your efforts in making my apprenticeship meaningful. A particular thanks to Jessica for teaching me a "dissertation short-cut" doesn't exist and her profound help with my methodology. I would especially like to thank Yaoying. She taught me the real meaning of the expression: "The teacher is the second parent" and provided a model of the ideal mentor for me to be for my future students.

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A personal thanks to my family. You have always been supportive of my education in so many ways. Eternal thanks to Miss Cindy Foster, the love of my life. I can never thank you enough for everything, but I plan on spending a lifetime to do so.

Epigram

"While I'm still confused and uncertain, it's on a much higher plane, d'you see, and at least I know I'm bewildered about the really fundamental and important facts of the universe." Treatle nodded. "I hadn't looked at it like that," he said, "But you're absolutely right. He's really pushed back the boundaries of ignorance."

They both savoured the strange warm glow of being much more ignorant than ordinary people, who were only ignorant of ordinary things.

-Terry Pratchett
Equal Rites

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Abstract

The study explored the relationship of play and development in adolescents. It was developed to determine if play in adolescents has a cognitive developmental purpose. The research design was a quantitative study with qualitative elements. The design of the study consisted two groups of participants who engaged in either a computer program to test cognitive skills or a computer game which contains the same tests. The participants (N = 216) were adolescent males and females (ages 12-19) from urban mid-Atlantic Catholic high schools. After vetting the data, the total was N = 167 and only included males (ages 14-19). The study indicated that adolescent males performed the cognitive tasks of memory and reading better in the play condition than the work condition and performed the cognitive tasks of logic and mathematics better in the work condition than the play condition. Differences in performance related to age are not present. This study suggests that play may have an effect on adolescents' cognitive development; therefore, it can be used as an effective method for some types of instruction. The study may contribute to the literature with the groundwork for further research exploring the cognitive nature of play in adolescents and its potential impact on identity formation.

CHAPTER 1 INRODUCTION

Nigel Hall (1991, p. 4-5) argues that learning in the late 20th Century:

required the de-skilling of learners: children had to ignore everything they know about learning and submit to the ownership of their learning by teachers, publishers, and university academics. The consequence was that the process of learning literacy became very complex, ritualized, and, for the most part, utterly divorced from either pleasure or reality. Many children failed.

In other words, children come to dislike the process of learning because educators make the education feel like work rather than an extension of natural play and learning processes. Gray (2009) demonstrates in his research that the division of work and play does not have to occur, and in many more "primitive" societies, adults find a joyful play-like attitude in their work. It is only in developed nations that it is assumed that pleasure and work must be divorced and that work is preferable to play in order to become successful.

The problem is exacerbated when children move from early childhood into adolescence. As children grow up, teachers feel they must prepare children for adulthood by removing the elements of play from education. This process is ultimately ineffective because the work of self-actualized adults shares the same aspect of pleasure that children derive from play. Removing play from education prepares students for a bleak, rather than fulfilling adulthood because it teaches that enjoyment and work are two separate concepts (Frost, 2010).

The current drive for standardized testing results is changing the educational system. Students are leaving school without the problem-solving and creative skill-sets needed to compete in the global economy (Darling-Hammond, 2010). Moreover, the

Taylor and Weber organizational models first proposed for the business sector have overcome the educational arena with devastating results (Love, 2008). Even the adolescents learning under this model understand and feel something is wrong with how they are currently being educated. A 2009 survey of 42,000 public high school students found 42 percent of high school students contemplated dropping out because they saw no relevance in what they were learning (HSSSE, 2009). A survey conducted by the National Governors' Association found that more than one-third of a sample of over 10,000 high school students considered dropping out because they were not learning anything (NGA, 2005). Finally, a Gallup Poll concluded that out of 800 students aged 13-17, when asked how they felt about school, more than half felt "bored," and 42 percent felt "tired" (Gallup, 2004). Adolescent Play Theory attempts to push the pendulum into the other direction, away from the business model of learning and back into the aesthetic and social values of education. It should allow educators to begin to blend the pleasures of play with the rigors of work in a way that allows educational experiences to become meaningful.

Background for the Study

Play Theory is the study of how people, particularly children, play. It has been researched from different perspectives, such as cultural or evolutionary, and modes, such as use for instruction or therapy, for nearly a century (Bruner, 1976). However, Play Theory is difficult for social and behavioral sciences to explore because the definition of play is difficult to operationalize. Bruner (1976) stated that several behavioral scientists have remarked that play should not be studied because of the difficulty of creating an

operational definition. Nevertheless, much has been theorized and learned about play through experimental studies.

The theoretical literature on developmental play theory has been posited in Piaget (1976a, 1976b, 1976c) and Vygotsky's (1976) work. The theories are limited in three respects: progression of play types, motivational effects of play, and adolescent play.

Piaget's types of play are directly related to his theory of cognitive development (Smith, 1994). The problem with this progression is that it undermines the concept that adolescents and adults would not engage in play because it would imply play at these stages is cognitively unnecessary. Vygotsky (1976) almost answers this problem by stating that the study of play should not focus on cognitive domains, but should rather take into account other developmental memes as well-social and physical. However, he does not explicitly answer this problem.

Neither psychologist explores the motivational aspects of play. They both assume play is pleasurable and that children engage in play because it is what children inherently desire or because it is what they are developmentally pushed to do. They do not examine or consider how play motivates behaviors outside of play, even though Vygotsky (1976) acknowledges play is wish-fulfillment, not of specific desires, but as a generalized affect and has a developmental roots, as children engaging in play could be displeased by the outcome of a game. The research, as of yet, has not thoroughly investigated this aspect of play and motivation. Piaget (1976a, 1976b) seems to think that play is motivated for sensory reasons, but again, like Vygotsky, he is not clear in his position.

In Piaget's theory of development, children progress through different stages of cognitive abilities. These stages are hallmarked by certain abilities, such as being able to

differentiate size and volume. The final stage of development called Formal Operations is the development and application of abstract thought. Piaget's play theories normally end with the Formal Operations because play follows development (Cohen, 1993). One of the reasons the field of play with adolescents has remained largely unexplored by academia is that Piaget stopped examining play as children entered into adolescence. Other reasons may derive from the fact that outside of childhood play is seen as a trivial behavior not linked to any important developmental processes or that in Western cultures play outside of childhood is discouraged or undervalued (Gray, 2009) and, therefore, is considered not worth study.

Vygotsky (1931) does touch upon adolescent development of creativity but does not discuss play. Instead he argues (1976) "that imagination in adolescents and schoolchildren is play without action."

While this is true, the split between the two may not be as clear-cut, particularly when wish-fulfillment is examined as a part of play development. Because adolescents do not engage in fantasy play in public settings-they generally choose to engage in Games with Rules, it does not mean that they do not have rich, private fantasy lives that are acted out behind closed bedroom doors.

Adolescents appear to have a desire to engage in certain types of play, such as fantasy play, yet strong social pressure prohibits the open expression of such types of play. Nevertheless play cannot be repressed, regardless of the situation (Frost, 2010), as demonstrated historically by the sufferings of slave children in America. Black children were whipped for engaging in play and not tending the fields; however, strong historical evidence indicates that these children engaged in play. With such a strong natural

compulsion, adolescents must find an outlet for their play. Educators have the opportunity to use this natural developmental compulsion to develop curricula based on the psychological principles driving play.

The nature of adolescent play must be examined first to determine the best methods for developing curriculum based on Adolescent Play Theory. In the same way that neuroscience has impacted educational methods with new research on attention spans, emotional control mechanisms, and memory formation, the study of play can lead to sound, science-based curricula.

Brief Overview of the Literature

Definition of Play

Throughout the literature, there have been many different definitions of what constitutes play activity. Gray (2009) synthesized the current discussion about the definition of play and created the following five characteristics of a play activity: (1) self-chosen and self-directed; (2) intrinsically motivated; (3) structured by mental rules; (4) imaginative; and (5) produced within an active, alert, and non-stressed mental state. These characteristics generally hold true across play theory, with slight variations and interpretations of each of the characteristics depending on the perspective of individual play theorist.

History of Play Theory

Play has been discussed and theorized since the earliest days of philosophy (Frost, 2010). The discussions of play in the ancient world focused on how to use play in order to best serve the educational needs of children. Plato and Aristotle (Plato, 1952, p. 384; Plato, 2000) discussed play in similar manners. Play should be strictly controlled by

educators as a means for developing natural talents and at the same time preventing play from causing children to practice bad habits. Other early philosophers, like the Roman Quintilian (Smail, 1938), reflected beliefs of their times that play should be used to develop specific skills, such as oration.

Belief in the value of play was extinguished with the decline of the Roman Empire in 495 A.D. The rise of Christianity led people to believe that childhood was a miniature adulthood that must be finished quickly because work glorified God (DeMause, 1974). These attitudes towards play were held by the general population until the late-Victorian period (Frost, 2010).

Play found champions in the early-modern period with Rousseau and Fröbel. Rousseau's theory of play as a form of natural instruction was introduced with his work *Emile* (2001). In this work Rousseau contended that play was a form of natural inquiry that helped a child develop inquiry skills necessary for later life and education. As Rousseau writes: "for what games do they play in which I cannot find material for instruction in them?" (2001, p. 133).

Fröbel took Rousseau's work, through Pestalozzi's writings and teachings, to form the first kindergartens. An integral part of these first "children's gardens" was play. Fröbel considered play not to be superfluous, but, "the highest development in childhood, for it alone is the free expression of what is in the child's soul . . . children's play is not mere sport. It is full of meaning and import" (Fröbel, 1887, p. 22). Fröbel's work in early-childhood has had lasting effect on early-childhood education today (Frost, 2010).

Developmental Theories of Play

Both Piaget (1976a, 1976b, 1976c) and Vygotsky (1976) examined the relationship of play and development and shared many commonalities. The first is that play progresses as a child gets older. Certain types of play are common with children of a particular developmental age (Cohen, 1993) and each step is an active part of development. Children play, not solely because it is amusing or fun to play, but because serious developmental work is occurring in the child through play (Piaget, 1976a, 1976b, 1976c; Vygotsky 1976). Play is a fundamental human process in which all people participate up to a certain age (Piaget, 1976c; Vygotsky, 1976). Where these two theorists diverge is in how they approach the specifics of these concepts and the fundamental relationship between learning and development. For Piaget, development precedes learning; for Vygotsky, learning precedes development.

Piagetian Mastery Play (1976a), play involving the transformation of actions originally serving exploratory or functional purposes (such as grasping and throwing toys), eventually leads to Symbolic Play (Piaget, 1976b). The developmental purpose of Symbolic Play is for a child to explore social contexts and signals by transforming objects into symbols for other things, (e.g. using a book as a pillow to "sleep.").

Symbolic play eventually leads to games with rules. Playing games with rules is a vital step in Piaget's progression as it ultimately generates the moral development of children. Play (Piaget, 1976c), is how children learn social constructs. In order to participate in games with rules, children must adhere to artificial rules that are without consequence (e.g. parental reprimand) if they break them other than the game itself being ruined. These negotiable rules must be agreed upon by the children playing the game.

Symbolic development is an important step because without it, the abstract thought processes needed for rules would not exist.

Vygotsky (1976) focused his work and theory on the linguistic, cognitive, and social functions of developmental play. Children engage in play for developmental reasons because engaging in games can lead to displeasure. Vygotsky cautions that while play does have cognitive elements, it cannot and should not be seen as only a cognitive function, and most developmental psychologists focus too readily on cognition.

Linguistic development is the root of play and fantasy play. Play, according to Vygotsky (1976), derives from wish fulfillment. A child is unable to have immediate gratification-"I want to ride the horse now"-, so he defers it into fantasy play-"rides a stick while pretending it is a horse." This affective desire leads to the development of symbolic reasoning. The child subverts the literal meaning of the object into a meaning that is desired in the present. Subversion, however, has limitations. A child cannot imagine a postcard to be a horse; there must be an approximation.

Approximation gives rise to the Zone of Proximal Development. This zone, proposed by Vygotsky (1978), relates to the developmental ability of a child. Children have the ability to stretch beyond their normal developmental capabilities under the correct circumstances. Play serves as a lubricant to this stretching, and peer-play is more effective than adult intervention (Vygotsky, 1976). It is through play that an adult can guide a child into pushing cognitive and social development.

Vygotsky makes a similar argument as Piaget about the social development of play (1976). The argument aligns with the belief that games with rules create social negotiation. Vygotsky takes a slightly different stance than Piaget, arguing that the rules

are malleable in process of play and that the negotiations have more to do with linguistic development (i.e. what was really meant by the rule).

Research into Instructional Play

Research into play as a method of instruction has a clear trend. The current research is broken into two main branches: the use of open-ended play as a method of allowing children to explore and self-choose skills to develop and the use of close-ended play activities directed by instructors to teach specific skills and lessons.

Research into open-ended play instruction has found that play is an effective method of instruction. When engaged in this type of instruction, children can generally perform tasks outside of their normal developmental capability (Broadhead & English, 2005; Graue, 2010; Hall, 1991, 1994; Malaguzzi, 1998; Smith, 1994;). Children in these studies also attached greater enjoyment to the educational process and developed an understanding of the purpose for which they were learning (Hall, 1991). Research also validated Vygotsky's (1976) theory that play could be guided by adults to generate higher levels of performance (Hall, 1994; Kitson, 2005).

Research into close-ended play instruction is more expansive than open-ended play instructional research. Research in this field has been performed in a variety of academic disciplines with children: literacy (Rowe, 2000; Williamson & Silvern, 1991), science and math (Caswell, 2009; Griffiths, 2005; Hamlen, 2009; Howe & Davies, 2005), and art (Duffy, 2005) to name a few. The consensus of the research literature is that children perform better within play-contexts than within traditional instructional settings.

Adolescent Developmental Theory

The developmental theorists whose work into adolescence most related to the theory of play are Piaget (1991), Vygotsky (1931), Erikson (1991), and Marcia (Muuss, 1991). Piaget and Vygotsky's work focus on the cognitive development of the adolescent. Piaget's (1991) work elaborates the process of how children becoming adolescents develop the ability to empathize with others because they are able to make use of abstract logical skills. Vygotsky's (1931) interest lies mainly in the creative development of adolescents. He postulated that during adolescence, a person begins to internalize play which leads to the development of imagination and creativity. Erikson's (1991) seminal theory on development posits that a person undergoes a series of conflicts generated by biological triggers. An adolescent must resolve the conflict of identity versus role confusion. Marcia (Marcia, 1966; Muuss, 1991) complemented Erickson's theory by furthering his work with the adolescent conflict of identity development. He categorized the particular stages through which a teenager passes as the conflict is resolved: diffusion, foreclosure, moratorium, and identity achievement. Each of these states has particular characteristics which explain adolescent behavior.

Adolescent Cognitive Theory and Research

Recent research into cognitive development has shown that the adolescent brain has not fully formed and continues to develop well into the mid-twenties (Sousa, 2005). The development of the adolescent is denoted by certain neurological characteristics. The first is the concept of critical periods (Diamond & Hopson, 1998). Critical periods are times when neurons are able to develop towards certain types of learning after which the neurons will be re-assigned to other types of learning. The end-effect of this

reassignment is that learning in the domain assigned to the critical period is more difficult, and in certain cases, such as linguistic development, impossible. The second concept is the development of the frontal lobe and emotional control (Goldberg, 2001; Sowell, Thompson, Holmes, Jernigan, & Toga, 1999). During the later stages of adolescence, emotional control is poor because of continuing development. The last important neurological principle important to adolescent learning is that of emotional memory. Research has found that positive feelings towards learning and the learning situation generate higher levels of retention (Sousa, 2005). This fact becomes particularly important in adolescence as emotional development is the foremost critical period being developed.

Adolescents, Play, and Technology

Gee (2003) postulated that video games were exemplary teachers because they employ a variety of teaching strategies that create highly effective learning environments, such as overlearning and graduation of experience. What he is in effect arguing is that the cybernetic principles of video games are what make them effective. However, video games as teachers are different because while those playing them learn specific sets of highly complex skills, such as keystroke combinations and audio-visual recognition, those participating in them find them enjoyable.

Gee (2003) and Gentile and Gentile (2007) have examined this aspect of adolescent play with video games and have suggested that the power of video games to attract and maintain the attention of adolescents and children derives from the principles of learning employed by games. This suggestion does not completely explain the power of video games nor how and why adolescents engage in these types of games. The power

of video games as a teaching tool may lie in the fact that they invoke fantasy elements, and, therefore, tap into the developmental needs of adolescents.

Istomina's Study

One of the first researchers into play was a Soviet psychologist, Zamora Istomina. Istomina's study into voluntary memory laid the groundwork for the research of play being related to the Zone of Proximal Development and the motivational aspects of play (1975). In her study looking at voluntary memory, Istomina examined two groups of children. She informed one group that there was a list of words to be memorized and that they would be presented with a quiz at the end of the study period. The other group received the same list of words, but rather than being told to memorize the list of words, they were informed that the words were a part of a grocery list and they were going to pretend to be in a store shopping for the items. At the end of the learning period for each group, Istomina compared how well the children were able to memorize the lists of words. What she found was that the group who were asked to engage in fantasy play had higher levels of retention than the group who were just asked to study.

Replications of Istomina's Research

Several studies since Istomina's work (1975) have supported her findings (Meacham, 1977; Paris, 1978; Smirnov & Zinchenko, 1969) that children's memory and learning are directly linked to meaningful contexts. The replications of Istomina's work have usually duplicated her findings, though not all of them have (Reese, 1996). Critics of Istomina's work argue that her findings are not valid because of methodological issues and issue that memory and learning occur better in instructional situations when the learning goals are clear and the tasks are properly presented (Weissberg & Paris, 1986).

Reese (1996) contends that the reason that Istomina's research has mixed results in replication is that no one has directly replicated her study and then changed research parameters, but rather, too many parameters are changed before the replication to actually give a solid result. This changing of methodology accounts for why many of the researchers are able to achieve similar results, but albeit less conclusively, while other researchers, such as Weissberg and Paris (1986), are unable to replicate them at all.

Rationale for the Study

An examination of the extant literature in play reveals a gap in the current thinking and understanding of how and why adolescents play. Is play important for adolescent development? While developmental play theories are rich in explaining how and why children play (Piaget, 1976a, 1976b, 1976c; Vygotsky, 1976), the theories cannot carry over into adolescence as adolescents are developing differently than children-as discussed by Erickson (1991) and Marcia (Muuss, 1991). Therefore, because of the difference in development, play must have a different relationship to cognitive development, if it is linked to development in adolescents.

The research into adolescent use of technology and video games (Gee, 2003; Gentile & Gentile, 2007) suggests that adolescents do play and are playing in a rich fantasy mode (Gee, 2003). The research into early childhood instructional play suggests that one of the hallmarks of play, particularly fantasy play, is that it activates the Zone of Proximal Development (Vygotsky, 1978) with learners. The neurological research has implied that the reason that the Zone of Proximal Development may be so powerful during play situations has to do with the importance of emotional states during learning (Sousa, 2005).

If these statements are true, then a research study examining whether the Zone of Proximal Development exists for adolescents who engaged in play would indicate whether or not play for adolescents has developmental purposes related to cognition. Istomina's (1975) study, while originally examining a cognitive trait in early childhood, would provide a basis for determining the presence of the Zone of Proximal Development in an adolescent population. The rich body of replications of the original study would also give a researcher the ability to craft a methodology which corrects some of the shortcomings of the original work and develop a design more suited to the adolescent population.

Purpose for the Study

The purpose of this study was to determine if the Zone of Proximal Development (Vygotsky, 1978) exists in an adolescent population engaged in fantasy play. If it does, in what way, and to what extent does adolescents' play affect their cognitive skills, as indicated by their test scores in memory, reading, logical reasoning, and mathematical reasoning? The study determined the existence of the Zone of Proximal Development in adolescents by developing a theoretical replication (Reese, 1996) of Istomina's (1975) study into voluntary memory. While a study into voluntary memory would be inappropriate for adolescents (voluntary memory forms at the age of five), a theoretical replication of Istomina's study would determine if the Zone of Proximal Development existed in adolescents engaged in play for cognitive purposes. In addition to memory skills which are basic throughout the human development, this study expanded the skill areas to reading and reasoning that are developmentally appropriate for adolescents.

Research Questions

The research questions for this study are as follows:

1. To what extent do adolescents perform basic cognitive tasks, specifically memory, reading, logical reasoning, and mathematical reasoning skills, differently during fantasy play situations than in instructional situations?
2. Is there a difference in the age group of the adolescent (middle: 14-16; late: 17-19) and how basic cognitive tasks, specifically memory, reading, logical reasoning, and mathematical reasoning skills, during fantasy play situations are performed?
3. Do adolescents' age, socio-economic status, and overall academic performance predict their cognitive skills in memory, reading, logical reasoning, and mathematical reasoning during fantasy play situations vs. instructional situations, respectively?

Design and Methods

The study followed a quantitative experimental design with qualitative elements.

The participants in this study were drawn from one Catholic co-educational middle school and two single-sex Catholic high schools in an urban area in a mid-Atlantic state. The participants were chosen on basis of age groupings: 8th, 10th, and 12th grade students. The purpose for such selection was to create a homogenous selection of participants on the basis of socio-economic status, general educational experiences, and race/ethnicity. The Catholic school system in the mid-Atlantic urban setting where the study was conducted has a population which meets the desirable homogeneity requirements of the study. Also, the system has two comparable

independent single-sex schools which were ideal to test for differences in gender participation in play.

While a random sampling does reduce threats to internal validity, with a sample that is basically homogenous, it is possible to determine that differences in groups are due to treatments, not participant effects (Mitchel & Jolley, 2007). Questions were added to the treatment to determine the homogeneity of the sample.

A group of 216 participants were randomly assigned either to the treatment group or to the control group in this study. The method was based on a theoretical replication of Istomina's (1975) study. Corrections were made to the original methodology to allow the research to test directly the secondary findings of her study for an adolescent population—namely, children perform cognitive tasks better in a play condition than a work condition. The main differences in methodology include the use of a computer to deliver the treatment conditions and the extended cognitive skills for adolescents. Rather than a fantasy game, a computer game was developed, so as to be culturally relevant.

The group comparison design study measured the amount of correct responses given in each treatment group and control group for the cognitive tests. An analysis of the data using Analysis of Variance and Linear Regression revealed if Istomina's (1975) findings hold true for an adolescent population and to what extent. Qualitative data was also collected to examine if the participants were actually engaged in play and to determine the nature of their play interactions within the treatments.

Definition of Terms

Play- An activity which contains the following five characteristics: 1. self-chosen and self-directed; 2. intrinsically motivated; 3 structured by mental rules; 4. imaginative; 5. produced within an active, alert, and non-stressed mental state. (Gray, 2009).

Fantasy Play- Play in which the player takes on a role through pretend or imagination to be someone else. Play of this type involves imitation of the actions and speech patterns either through firsthand or secondhand observation and experience of the imitated subject, usually in already understood situations (Smilansky, 1990).

Zone of Proximal Development- The cognitive state between developmental abilities and new skills (Vygotsky, 1978). The Zone of Proximal Development exists when learners are attempting to perform tasks that are just beyond their current developmental capabilities.

Methodological Replication- A replication study which attempts to precisely replicate the methodology used in the original study (Reese, 1996).

Theoretical Replication- A replication study which attempts to replicate the theoretical findings of a study by aligning methodology for particular participant groups (Reese, 1996).

CHAPTER 2

LITERATURE REVIEW

The review of literature begins with a discussion of the definition of play. This discussion is vital due to a lack of consensus in the academic community about the definition of what qualities constitute a play activity. The discussion of the term play is followed by the methodology of the literature review. The methodology section explains the methods used to determine what literature was employed in this review, as the literature of play is quite extensive and covers several different domains, including therapy, kinesiology, and philosophy.

The review of the literature continues by discussing the cultural-historical perspective of play in Western culture. The purpose of this discussion is to illuminate the cultural bias of the current research. Following the cultural-historical perspective is a discussion of developmental theories posited by Piaget and Vygotsky, as they relate to play. The review of the literature then highlights the themes in the extant literature relating to play and instruction in early childhood. The review further explores the current developmental and cognitive theories and research related to adolescent development. A bridge between developmental play theories, adolescent developmental theories, and cognitive research into adolescence is presented next. The review concludes with a review of major replications of Istomina's (1975) study into voluntary memory as a way to test the gap in the literature.

Definition of Play

Play Theory is the study of how people, particularly children, play. It has been studied from different perspectives and modes for nearly a century (Bruner, 1976). Play Theory is difficult for social and behavioral sciences to analyze because the definition of

play is difficult to operationalize. Bruner (1976) states that several behavioral scientists have remarked that play should not be studied because of the difficulty of creating an operational definition. Nevertheless, several different qualities which facilitate defining an activity as play are currently employed by the literature.

Throughout the literature, there have been many different definitions of what constitutes a play activity. Gray (2009) synthesized the current discussion about the definition of play and created the following five characteristics of a play activity: (1) self-chosen and self-directed; (2) intrinsically-motivated; (3) structured by mental rules; (4) imaginative; (5) produced within an active, alert, and non-stressed mental state. These characteristics generally hold true across Play Theory, with slight variations and interpretations of each of the characteristics depending on the perspective of individual play theorist.

Two of the characteristics, self-chosen/self-directed and intrinsically-motivated, need further clarification. Gray (2009) posits that the hallmark of play is that the participant has an active and easy choice as whether or not to participate in the activity. When choice in participation in the activity ceases, the activity becomes work rather than play. The rationale behind this characteristic has to do with the ludic aspect (Piaget, 1976a): play must be enjoyable and choice is inherent in the enjoyment of an activity. Vygotsky (1976) disagrees with this position. He argues that play is not always "done solely for pleasure" because engagement in a game creates an opportunity for suffering (through the loss of the game). Play, therefore, has developmental motivations as well as ludic motivations. If this is the case, then an activity in which a participant is engaged, but does not have a totally active choice in participation, could still be considered play.

In order for the activity to remain play, it must still contain the ludic aspect (Piaget, 1976a). So, a degree of choice must exist within the activity, such as how the participant engages rather than solely his participation (e.g. children who must play soccer in gym still have the choice as to what position they play and the choices they make within the actual game, even though they have no choice as to whether or not they participate).

The second hallmark of a play activity, intrinsic motivation, needs clarification as well. Even Gray (2009) acknowledges that the line between the "pure play" of younger children and play in older populations can become blurred. Just as Vygotsky (1976) and Piaget (1976a, 1976b, 1976c) argued for developmental reasons for play, other motives may be at work as well. So while an activity may have an external motivator (e.g. teaching in order to earn money to raise a family), it can also develop a ludic aspect.

Ultimately, play is difficult to define because the motivation for the action is the determining factor in deciding what is play and what is not play. Vygotsky (1976) remarked that with older children it is more possible to define play because the children themselves can delineate play from other activities in which they engage. Regardless of the difficulty of defining what activities count as play, play does have a value to instruction and should be continued to be explored and researched (Bruner, 1976; Frost, 2010).

Methodology of Literature Review

In order to create a systematic review of the literature as it relates to play, the historical significance of play in Western Civilization has to be examined because play is directly affected by cultural influences (Rogoff, 2003). Without determining the cultural influences which inform the current Western cultural perspective on play, any research

conducted will not be able to reflect its own bias. Within the historical perspective, writers whose contributions significantly shaped the perspective of how play and instruction are traditionally viewed are included.

Piaget and Vygotsky's developmental theories of play are presented . Their developmental theories of play were chosen because nearly all research into play can somehow be tied into their theoretical frameworks.

The review of literature examining the modern areas of play research has a tighter set of criteria than the previous sections of the review. Research that has been conducted into play as a form of instruction was considered because little literature directly tests developmental theories, but play-based instruction research tests those theories through applied research. Play research is generally qualitative in nature due to issues with operationalizing definitions of play (Bruner, 1976) for quantitative research. To compensate, both qualitative and quantitative research were used for the review. Frost (2010) has remarked that throughout generations, play has held remarkably similar appearances in how and why it is expressed. Because of the universality of play through time, research since the writings of Vygotsky and Piaget, ca. 1930s, were considered. Research before this time was not systematic or lacked a consistent theoretical framework.

The search technique for examining articles related to play was a snowball technique to gather the general consensus as to how play is discussed. Because the search term "play" contains so much meaning (e.g. a theatrical production, play therapy, fantasy play, a metaphor for interactions in psychological research), it was difficult to use traditional search methods through data bases. For example, a metasearch through

Academic Research Complete using the truncated search terms "adolescen*" and "play" yielded over 26,000 articles. A narrower search using a single database source, Education Research Complete, employing the same search terms yielded over 1,000 articles.

A manual search of the catalogue of the Virginia Commonwealth University library was conducted to find research texts on play and instruction. The search yielded four texts to begin the search. Articles found in the texts were then used as a base to begin "snowballing" the search method. Bibliographies of the articles were used to develop the search pool. As the articles were gathered, they were scanned into a qualitative research program, NViVO, and then coded according to themes that emerged from the texts. The gathering of articles ceased when the discovered themes became saturated as to the nature of instruction and play. Using the American Research Association's guidelines for theoretical and empirical research quality standards (AERA, 2006), 38 articles were examined after vetting. The themes discovered using the technique are presented with examples of specific research that highlight those themes.

Both the developmental theories of Erikson (1991) and Marcia (Marcia, 1966; Muuss, 1991) were employed in the literature review, as they are the most comprehensive and most-cited relating to the developmental process of adolescence. Cognitive research relating to brain-structure was also examined to determine if a relationship between the developmental theories and play theories of early childhood existed.

Throughout the literature search, Istomina's (1975) study into voluntary memory appeared numerous times as empirical evidence for the validity of Vygotsky's theory of the Zone of Proximal Development. Her study and its major replications were

examined in detail as they offer a way to create a replication which would test the theory that adolescent developmental theories and play theory can be bridged.

A Brief History of Play Theory

Ancient Play Perspectives

Around 300 B.C.E., Plato asserted in his *Laws* that play is seen as a form of practice for adulthood (2000). In this early practice, adults would monitor open-ended play to determine the natural aptitudes of children and then develop those aptitudes into specific disciplines as children became older. Play, Plato argues (1952, p. 646), would allow children to "practise (*sic*) that thing from his youth upwards, both in sport and earnest, in its several branches: for example, he who is to be a good builder, should play at building children's houses; he who is to be a good husbandman, at tilling the ground; and those who have the care of their education should provide them when young with mimic tools." Like his teacher Plato, Aristotle believed play could be dangerous as it could lead children into developing bad habits and vices and should be strictly monitored by adults (1943).

The Romans had a different view of play and education. Education in the Roman Empire was the prerogative of the head of the household and varied greatly between families. About 85 A.D., the Quintilian summarized the Roman view of play. Play and leisure offered an opportunity for educators to know their students and stress memory skills, as this was vital to the concept of oration—an important Roman occupation of the upper-class (Smail, 1938). Quintilian did not object to play and games, as long as they could be used for instruction.

The attitude of the Middle Ages (ca. 900-1500 A.D.) was that children were miniature adults who had to work in order to glorify God (DeMause, 1974). The attitude of children being miniature adults persisted in popular thought through the Renaissance, the Enlightenment, and into the middle-to-late Victorian age (1880's A.D.). The value of play was either constrained to particular values, such as Locke's (1902) argument that children should only have toys to play with one at a time in order to learn self-restraint, or was viewed as being irrational and something to be "gotten over" as quickly as possible.

Early-Modern Play Perspectives

Educational play reform did not emerge until 1762 when Rousseau tackled the topic in his book *Emile* (2001). As it relates to play, *Emile* (2001) advocates play as central to a child's development. For Rousseau, the most important part of education is to teach a child to remain virtuous, while at the same time developing positive social contracts. In Rousseau's view, play promotes physical health and develops, as would be termed by later educational theorists, inquiry skills. Rousseau was the first to advocate that play was not frivolous, but was, in fact, the work of children in understanding their world and learning how to think. The purpose of a teacher in this paradigm is to work with individual students to help promote their open-ended play into developing reasoning skills. As Rousseau writes: "For what games do they play in which I cannot find material for instruction in them" (2001, p. 133)?

Rousseau's work influenced Johann Pestalozzi. Pestalozzi created schools based on Rousseau's educational philosophy as a method to improve the lives of the destitute. His work advocated kindness and respect to young children. In turn, his work eventually influenced a young teacher named Friedrich Fröbel, the father of the Kindergarten

Movement. Fröbel's work led to the development of the first true playgrounds and the development of play having a prominent role in the education of young people.

During the 1880's, Fröbel created the first kindergartens to educate children in a positive and loving environment. In these "Children's Gardens" play was given a central place in instruction. Children were encouraged to interact outside with basic toys such as blocks and tools. Fröbel believed that play allowed the natural gifts of an individual to come forward and be developed. Instruction that used play was to be interesting, pertinent to the learner, and joyous. Play is not frivolous; rather, "play is the highest development in childhood, for it alone is the free expression of what is in the child's soul . . . children's play is not mere sport. It is full of meaning and import" (Froebel, 1887, p. 22). Fröbel believed that "play at this time is of deep significance . . . the germinal leaves of all later life" (Froebel, 1887, p. 55). Fröbel's work has influenced early-childhood education for more than a century, being further developed by other prominent educational thinkers such as Dewey, Montessori, and Piaget.

At the turn of the twentieth century, educational philosophy was being influenced by Freud's work in psychiatry. Play, like all other phenomena of mankind, became subject to theorizing rather than philosophizing. The new theories of play attempted to view it as a specific psychological phenomenon of "what is" rather than a philosophical notion of "what should be." The early theorists maintained many of the principles of the philosophy of play, yet they framed these beliefs into generalizations about human behavior and particularly the concepts of psychological development.

One of the first theorists of play was Karl Groos. Groos (1901) viewed play in a way similar to Rousseau, Fröbel, and most contemporary thinkers. Play to Groos was

more like a miniature practice adulthood, rather than a period of exploration. His work mostly examined the habits of fantasy play and trying to understand why children seem to play house and occupational roles. While Groos (1901) would argue that play does serve the purpose of exploration and general-skill building that Rousseau and Fröbel advocated, he portrayed play as serving a highly utilitarian purpose, namely practicing adult skills and roles. The main tenet of Groos' thought about play is that play is a reflexive activity for children who do not engage self-reflection. Groos' work remained influential during the early part of the 20th Century until the developmental theories of play were postulated by Piaget and Vygotsky during the 1930's.

Developmental Theories of Play

Both Piaget and Vygotsky share the idea that play and development are related. Their theories of development share much in common. The first shared concept is that play progresses as a child gets older. Certain types of play are common with children of a particular developmental age (Cohen, 1993) and each step is an active part of development. Children play, not solely because it is amusing or fun to play, but because of serious developmental work being accomplished in the child through play (Piaget, 1976a, 1976b, 1976c; Vygotsky 1976). Play is a fundamental human process in which all people participate up to a certain age (Piaget, 1976c; Vygotsky, 1976). Where these two theorists differ is in how they approach the specifics of these concepts and the fundamental relationship between learning and development-for Piaget, development precedes learning; for Vygotsky, learning precedes development.

Piagetian Play Theory

Piaget's progression of play stems from very early-childhood (18 months to two years) until late childhood (ten years of age to the onset of puberty). The first step in Piaget's progression is Mastery Play (1976a). In this stage of play, children (ages 18 months to 2 years) engage in repetitive physical behaviors, not to learn from them (such as a child exploring how to throw a spoon from a high-chair), but for a ludic aspect (the same child, having mastered the skill, continues to do so "for fun"). For Piaget, this stage of play is the most rudimentary, as it is the stepping-stone for all other types of play (1976a).

The next step in the progression is Symbolic Play (1976b). In this form of play, children (aged 2 years to 7 years) are able to approximate objects for other purposes. An example of this type of play would be a child pretending that a stick is a spoon. What Piaget noticed in this type of play is that it is mostly constrained to play regarding social concepts (1976b). The child imitates what is the socially-acceptable norm for these behaviors, or what it "should" look like. In this context, sisters could actually play a game where they pretend to be sisters because of a symbolic divide between the reality of sisterhood and the symbolic value of it. The terms Symbolic and Fantasy play for Piaget are remarkably similar and nearly indistinguishable as he uses the two types of play interchangeably (1976b).

The last step in play progression is Games with Rules. In the Games with Rules stage of play, children (ages 7 years to 11 years) begin to engage in formal games with each other. These games are important as they begin to teach children the value of the social contract and to develop morality. In these games, violating the rules has no

external punishment attached, such as taking a cookie from the countertop without permission would. Rather, the consequence of violating the rules is that the game is ruined. This fact alone holds enough consequence that children adhere to rules negotiated with peers.

Overall, the purpose of play for Piaget is not for children to push themselves to the next stage of development, but to develop more fully current and previous stages of development (Piaget, 1976a). As he argues in his essay on Mastery Play (1976a), Piaget feels that in order for a task to have a ludic aspect, the play activity should involve skills already mastered by the child. Otherwise, the activity is a learning or exploration activity, not a play activity.

Vygotskian Play Theory

Vygotsky (1976) does not break the progression of play into such detailed categories as Piaget does. For Vygotsky, only two stages of play are worth noting: Fantasy Play and Games with Rules. Fantasy Play is the primary interest of Vygotsky. For Vygotsky, this type of play is the most important as it develops a child in more ways than just cognitively (1976). He argues that children (aged 2-7 years) begin to engage in Fantasy Play as a method of wish fulfillment. A child who is unable to obtain an immediate desire, such as riding a horse, pushes that desire into a form that can be immediately fulfilled, such as riding a stick and fantasizing it is a horse. This inversion creates both linguistic development and the Zone of Proximal Development (Vygotsky, 1978).

The inversion of meaning, object, and words creates linguistic development because the child has to subsume the meaning of an object away from what it is called. A

"stick" becomes a "horse." This transposition of meaning is the beginning of the separation of words and ideas, which is closely related to the concept of developing abstract thinking skills. The Zone of Proximal Development (Vygotsky, 1978) is a concept that posits that children can stretch cognitive abilities when engaged in play. Children engaged in pretend play can push a linguistic concept (separating objects from meaning) that they could not do in a formal learning environment. Vygotsky noticed for many tasks that children could accomplish while engaged in play, particularly guided peer play, which they could not otherwise do (1976).

Games with Rules for Vygotsky is closely related to Fantasy Play. Vygotsky (1976) argues that Games with Rules is merely an extension of Fantasy Play. Children who are engaged in Games with Rules must fantasize in order for those games to make sense. The example given by Vygotsky relates to a chess game. A chess game is a fruitless and pointless activity unless fantasy is involved. A person engaged in chess fantasizes about the field of the game as being a battlefield, or at the bare minimum, fantasizes about beating an opponent. On the same token, Fantasy Play is Games with Rules because each fantasy enacted by a child must adhere to rules or the game is ruined. A child pretending to play house cannot suddenly change the house to a bank and still be playing house. Social rules govern thought processes. All games with rules are fantasy games and all fantasy games are games with rules.

The Zone of Proximal Development

The Zone of Proximal Development was first proposed by Vygotsky as it related to his play theory (1976). He further expanded this theory in both his work with adolescent psychology (1931) and in his work with the psychology of learning (1978).

The basic principle of The Zone of Proximal Development is that the divisions between developmental ability are not hard and fast as Piaget argues (Dworetzky, 1995), but are flexible which indicates a zone in a child's development between one developmental stage and another. Piaget believes that development strictly precedes learning; a child must have the appropriate biological/neurological development before certain tasks can be accomplished. Vygotsky believes that learning pushes a child to the next stage of development and then the biological/neurological development occurs (Vygotsky, 1978).

Play is important to the Zone of Proximal Development because play acts as a lubricant to the developmental process (Vygotsky, 1976). A child engaged in a play activity is more readily able to access the Zone of Proximal Development and push developmental ability. In other words, a child who is engaged in play is able to complete tasks that are developmentally too difficult. It is not implied that a child would be able to do significantly harder tasks (e.g. a 3rd grader doing calculus), but ones that are just beyond the current developmental or intellectual stage of the child. Rather, the tasks must be moderately difficult for the Zone of Proximal Development to be effective (e.g. a pre-school student being able to understand the magnitude of numbers).

The End of Play

Both Piaget (1976c) and Vygotsky (1976) maintain the position that play is the prerogative of children. Piaget's progression of play is closely linked to his concept of intellectual development. With the onset of Formal Operations, play seems to become unnecessary because it no longer serves a developmental purpose. For Vygotsky, play ends with the onset of adolescence. Vygotsky (1976) maintains that play and fantasy are closely related and that play is merely fantasy in action. As a child enters into

adolescence, play ceases to occur because the adolescent is able to separate action from fantasy and then internalizes play. Both of Piaget and Vygotsky maintain that play typically ends at about the age of 11-12.

Play and Instructional Theory

While Rousseau (2001) may have been the first to advocate the value of open play, it was Fröbel (1887) who really introduced play as a viable method of instruction. The current research into using play as an instructional method is divided into two main agendas: the use of open-ended fantasy play driving instruction or the use of specific instruction which incorporates play. The research into play and instruction for children is robust, and only a selection of studies is presented here to give a general concept of the trends in the literature.

Several researchers have worked on open-ended play as a method of instruction (Broadhead & English, 2005; Graue, 2010; Hall, 1991, 1994; Malaguzzi, 1998; Smith, 1994). These researchers were interested in the effects of allowing play to drive instruction. Rather than a teacher setting curriculum goals and then adding a play element to achieve these goals, the teacher allows the children to play freely and then incorporate lessons into the play. Several key findings have emerged from this body of literature.

Hall (1994) found that play in these contexts has a unique advantage. Play allows children to create meaning with literacies and learning. Hall's (1994) study on the topic involved using play areas inside of the classroom. By adding literary materials to the play areas, young children became involved with those materials and incorporated them into their play. Further, when a teacher guided literacy into the play, children were able

to perform literary tasks beyond their normal ability. Specifically, when the children played at "garage," a teacher who suggested writing letters of thanks or complaint found that the children wrote these letters with a more sophisticated language and tone than children engaged in normal literacy tasks. Children in this game were also able to complete large sections of an application for zoning (a real form from the zoning commission, not a teacher generated one).

Hall's (1994) research, aside from confirming the Zone of Proximal Development, also confirmed Vygotsky's belief (1976) that adults guiding play could have positive results. The research (Hall, 1994; Kitson, 2005) found that children who were guided by adults during play would have more rich and deeply meaningful play experiences than those who were not. This finding is not to say that adults should dictate the play of children, but rather they should be active participants, helping to guide where the play should go. This guidance should be restricted to asking the children to consider ideas not evident to the children themselves. For example, during a play session of "house" the teacher could pretend to be the family dog who suffers from a crisis, such as a broken leg. The introduction of a new problem allows the play to be guided in a different direction and help the children create problem-solving skills that would not otherwise be present.

The second branch of the research into play and instruction is more expansive than play-led instruction. The research into this area has found strong cases for using play as a method of instruction in reading and literacy (Rowe, 2000; Williamson & Silvern, 1991), science and math (Caswell, 2009; Griffiths, 2005; Hamlen, 2009; Howe & Davies, 2005), and art (Duffy, 2005).

The research is clear about the role of play and instruction: it works. Play allows children to interact with content in a deeply meaningful way that would not otherwise be allowed by traditional curriculum models. The teacher in these models guides the play and instruction, placing specific goals and rules on the play. Play supports constructivist learning and allows the children to own the material and to develop personal understanding. While currently little research has been conducted about adolescents and how they play, much is currently understood about adolescent development and cognition.

Developmental and Cognitive Theories in Adolescence

Developmental Theories

The instruction of adolescents is a particularly difficult prospect. Adolescents are going through many physical, emotional, and cognitive changes which are just as diverse, complex, and rich as those experienced in infancy. Added onto this time of change is a whole host of other contemporary issues which conflict with natural development (Sousa, 2005). Even though a multitude of different sources of change affects adolescents, most of them follow a fairly consistent pattern of development.

Both Piaget (1991) and Vygotsky (1931) tackled what they saw as the patterns of cognitive development in the adolescent. Piaget's (1991) theory primarily discusses the concept of Formal Operations in learning for the adolescent. In the immediate stage prior to Formal Operations, a child can begin to reason and create hypotheses based on observations of the physical world. Children are constrained in how they reason by how they perceive the world. Only what can be physically manipulated is considered for logical abstractions. In other words, a child, prior to Formal Operations, could reason

that if more water is added to a container that is nearly full, it will overflow; however, the child would not be able to use abstract logic to determine how a flush toilet would operate without having seen and worked with the mechanics of the device.

Piaget (1991) then continues his description of adolescent development by stating that the real hallmark of Formal Operations is the ability of an adolescent to form abstract principles from one logical situation and apply them to another. An adolescent is able to handle concepts such as if $A=B$ and $C=B$ then $A=C$. Moreover, the concept can be more complex, adding into it a principle of uncertainty that a child cannot handle. For example, if $A=B$ and $C=B$ then $A=C$, only if D is sometimes present.

Piaget's theory then progresses to the idea of social empathy (1991). Within the context of moral development, an adolescent is able to empathize because of logical abstractions. Formal operations allow adolescents to use logic to "see" the viewpoints of others, even if they do not hold that viewpoint. The complexity of this transmission is facilitated by the fact that an adolescent is able to divorce personal feelings from logical abstractions. Others, such as Elkhind(1991), have criticized Piaget's idea of empathy development because an adolescent could also develop empathy through social pressures and feelings of pleasure/discomfort from those social interactions.

Vygotsky (1931) takes a different approach when explaining the development of the adolescent. Vygotsky's work focused on the development of creativity and social learning. According to Vygotsky, childhood memes begin to end with the onset of adolescence because, as children develop, they learn new social roles suited for adulthood and adapt behaviors to fulfill these roles. Play becomes internalized as creative

imagination: "Imagination in adolescents and school children is play without action" (Vygotsky, 1976, p. 539).

Erikson's theory of human development (Erikson, 1991) is important for understanding adolescents. His theory, postulates that differing stages, or conflicts, are triggered by biological markers linked to age. As each of these conflicts is triggered, the individual must confront it, work through it, and progress to the next stage. The conflict that adolescents must overcome is that of identity versus role confusion. The adolescent must come to terms with what is meant by identity and form his or her own identity in the process.

Marcia (Marcia, 1966; Muuss, 1991) expanded Erikson's theory by detailing the process by which adolescents cope. Within this stage are four subsets amongst which an adolescent vacillates: diffusion, foreclosure, moratorium, and identity achievement. In diffusion, the adolescent explores different personas, attitudes, beliefs, subcultures, ideas, and memes while not attaching a deep significance to any of them. In foreclosure, the adolescent chooses a single pre-made identity (e.g. "I will be a lawyer when I grow-up") and refuses to engage in any exploration of other identities. Moratorium is similar to diffusion except that the adolescent is in crisis trying to find a workable identity. Identity achievement is the state of resolution of the identity crisis. In this state, the adolescent has explored different identities and has created a unique identity which matches his or her actual psychological make-up. An adolescent in this state is confident, happy, and secure.

Cognitive Learning Theories

The human brain is not fully developed at birth (Sousa, 2005). Rather, the brain develops over the lifetime of an individual, undergoing specific changes during certain stages of a person's development. This development leads to how a person understands the world and processes information at different stages during life changes. During the developmental period of adolescence three neurological principles of development come to the forefront of how an adolescent learns and perceives the world.

The first concept is the idea of windows of opportunity in learning. Research into neurological development has found that at certain periods of a person's life, neurons activate inside the brain that allow a particular type of learning to become prominent (Sousa, 2005). These periods include emotional control, spoken language, motor development, and others. These neurons only become active for a set amount of time, called a critical window, and when the window closes, learning in that domain becomes difficult. The current theory is that the neurons assigned for that type of learning are reassigned to other types of learning when the window closes (Diamond & Hopson, 1998). Some of these critical windows are so integrated that learning in the domain can become impossible after the window has closed—particularly language acquisition (Diamond & Hopson, 1998).

Recent research has developed the second concept that period of emotional development is still at work within adolescents (Goldberg, 2001; Sowell, Thompson, Holmes, Jernigan, & Toga, 1999). Because of the continuation of development of emotional control in the frontal lobes, adolescents demonstrate high-risk behaviors. It is this continual development that leads to choices made by adolescents which are governed

by impulsive emotional responses rather than controlled "adult-like" decisions.

Following the principle that mid-to-late adolescence is still a critical window for the development of emotional control, it is an important time to teach these skills before the neurons associated with them are re-assigned.

The last relevant concept is emotional states and learning. Sousa (1995) discusses the importance of learning with positive emotions. Positive emotional states during learning lead to a greater retention of material. Feick and Rhodewalt (1997) found that negative emotions relating to learning can create self-handicapping behaviors in future learning situations of similar material. Because learning in itself creates anxiety, as it is a period of going from uncertainty to certainty (Salzberger-Wittenberg, Henry, & Osborne, 1983), a positive and nurturing environment needs to be created for learning environments. Because adolescents are in a developmental critical period relating to emotional and identity development, life-long attitudes towards learning and ability in academic situations must be closely tied to this period of development. It is critical that educational experiences be positive as they will shape all future attitudes towards learning and how the adolescent will perceive future academic successes and failures.

Memory

Memory is the basis for how people learn. Much has been learned about memory since Istomina (1976) performed her original study into voluntary memory. At the time of Istomina's study, the relationship between short-term and working memory was not fully examined. Researchers at the time followed the intuitive thought that short-term memory was directly linked to long-term retrieval and that the nature of short-term memory itself was not fully developed (Radvansky, 2011).

Short-term memory is that which is only held by the brain for a matter of seconds before it must be handled by working-memory, if it is not rehearsed (Radvansky, 2011). The current thought about the capacity of short-term memory is that it can only hold five items, plus or minus two, for the average adult (Miller, 1956). The issue with capacity is that the idea of "items" can be broad due to a phenomenon known as chunking.

Chunking is the mind's ability to group individual items into larger "chunks" for easier memory retention (Sousa, 2005). For example, an average person could hold a series of five letters, plus or minus two, within short-term memory. However, the same person could hold seven words made of letters within short-term memory. By grouping letters into words, the mind effectively can hold a much larger number of letters in short-term memory (e.g. if each word had eight letters, a person could remember between forty-five and fifty-six letters).

Different situations can have an effect on a person's short-term memory. Expertise also has an effect on the carrying capacity of short-term memory as well (Ericson, Chase, and Faloon, 1980). A person who works with a particular set of data can have a higher rate of memory for specific tasks. For instance, a receptionist can hold phone numbers in short-term memory better than a person who does not regularly work with numbers. Age can also have an effect on the amount of items held in short-term memory. The capacity to hold a full-set of five items, plus or minus two, does not develop until middle puberty at about age fourteen or fifteen (Sousa, 2005). The previous age group (three to thirteen) can only remember about three items, plus or minus two.

Working memory is different from short-term memory, but the two memory functions are related (Baddeley, 1992). Prior to Baddely's seminal work on the topic

(1986), it was thought that short-term memory had a direct impact on learning. Baddely (1986, 1992, 2000) worked to explore the nature of working memory. In his work, he found that working memory was more responsible for long-term memory storage and the ability to problem solve.

Earlier research into memory also worked with a belief in memory decay. Memory decay was the concept that information decayed out of short-term memory at a constant rate (Brown, 1958; Peterson and Peterson, 1958) and was completely forgotten in roughly thirty seconds. A newer theory called interference more accurately describes what occurs during the period known as decay. Interference suggests that the world continually presents information to a person and because a person's short-term memory is limited, old information in short-term memory is forgotten and replaced by newer information. Research has supported this hypothesis (Keppel & Underwood, 1962; Waugh & Norman, 1965). Rehearsal of items can help refresh items back into the short-term memory cycle.

Baddeley's (1986) model divided working memory into four components: (1) the phonological loop, (2) the visual-spatial sketchpad, (3) the episodic buffer, and (4) the central executive. In short, the phonological loop (linguistic information) and visual-spatial sketchpad (visual and kinesthetic information) handle differing types of information and how they are processed. The episodic buffer acts as a go-between for the information handled separately by the phonological loop. The central executive is the part of working memory which guides which resources are allocated to each of the different parts of the working memory system as the entire system has a limited capacity

for handling information. In essence, the central executive decides what information is unimportant and, therefore, forgettable, and what needs to be retained.

Further research into memory has discovered particular effects which can hinder how a person processes information within the phonological loop portion of working-memory. The first is the word-length effect. Research (Baddeley, Thomson, & Buchanan, 1975) has found the articulation duration (not spelling or syllabic length) can affect how much a person can hold in working-memory. Longer sounding words use more cognitive resources than shorter sounding words, even if they have the same syllables (e.g. wicket v. harpoon) and are harder to remember. This effect is seen even in persons who cannot speak (Baddeley & Wilson, 1985).

A second effect is irrelevant speech. A person working with linguistic information has a harder time focusing when irrelevant speech is in the background, even if the language is not understood by the person using working memory (Colle & Welsh, 1976).

A third effect is phonological similarity. When words share similar sounds in a list of words to be worked with, working memory has a more difficult time processing the words and remembering them (Baddeley, 1996; Conrad & Hull, 1964). This effect is intensified when the words are alliterative and reversed when the words rhyme (Gupta, Lipinski, & Aktunc, 2005).

The last important effect to be noted is the concept of semantics. Semantics suggests that working memory is affected by use of prior knowledge and the lexicality of the items in a list (Hulme, Maughan, & Brown, 1991). In this effect, long-term memory can solidify items in working memory by relating them to prior knowledge. Also, words

embedded in a sentence give working memory a higher probability for recall because long-term memory interacts with it.

Reading Comprehension

Reading comprehension is an important cognitive skill for success in modern European and European-American school systems (Rogoff, 2003). Reading is a gateway cognitive skill to other types of learning. The correlation between the task of memorizing a list of words and reading comprehension is weak (Perfetti & Lesgold, 1977), unless the participants have severe developmental issues. This fact seems to be a part of the universal consensus in literacy research, as no one has developed a research line after Perfetti and Lesgold's (1977) research to test the relationship.

Working memory and reading comprehension are linked (Bernigner, Abbott, & Swanson, 2010; Cong and Zhao, 2008; Goff, Pratt, & Ong, 2005; Swanson, Zheng, & Jergman, 2009; Woolley, 2010; Waters and Caplan, 1996). The debate about the nature of this relationship as scholars have not developed a consensus about the specific relationship between working memory and reading comprehension, or even what is meant by these terms.

It has been found that Reading Span Tests designed to measure the ability of working memory to handle realistic memory tasks are good predictors of reading comprehension. Daneman and Carpenter's (1980) Reading Span Test is a widely used method for testing working memory. The test was created using the theory that reading memory uses different processes than list memory (i.e. remembering items in a list). The test was developed to incorporate both comprehension and memory by generating longer

and longer sets of sentences and then asking the reader to remember the last pair of words in the set.

Theorists debate about what the Reading Span Test actually tests (Georgiou, Hayward, and Hayward, 2008; Guida, Tardieu, and Nicolas, 2009). The debate centers around the creation of the test, its original intention, and what it actually does (i.e. does it test the process of reading or a specific aspect of memory related to reading?).

While theorists debate that the Reading Span Test actually tests a specific or general reading skill, the test remains a good predictor of reading comprehension (Barr, Kamil, and Mosenthal, 1996). Those who score low on the Reading Span Test, score low on universal comprehension reading tests with a fairly high reliability (.42-.90 with modal being .55). The Reading Span Test, though, has some serious flaws (van den Noort, et al., 2008). Recent European research has designed a new form of the test to correct these problems (van den Noort, et al., 2008), and it shows promise for cross-cultural and linguistic comparisons.

Logical Reasoning

The acquisition of formal logical reasoning is vital for success in European and European-American schooling (Rogoff, 2003). The study of how children progress into adults and develop logical reasoning is a wide field. Within the field, three major theories about the development of logical reasoning in children are currently employed (Bara, Bucciarelli, & Johnson-Laird, 1995); however, none is fully viable as they cannot explain the entire phenomenon of logical development (Johnson-Laird, 1990).

The first theory is that children develop logical reasoning skills through educational processes and experiences (Falmagne, 1980). This theory coalesces with

Vygotsky's (1976) theory of the Zone of Proximal Development as it suggests that learning precedes development. The second theory is the one postulated by Piaget (Inhelder & Piaget, 1964, pp. 292-293) —that logical reasoning, particularly syllogistic learning, is achieved through the developmental process of Formal Operations and equilibrium (automatic-self regulation). The third theory is that of mental models. The Mental Models Theory asserts that "reasoning depends instead on a mastery of referential language and on the ability to search for counterexamples" (Bara, Bucciarelli, & Johnson-Laird, 1995, p.158). The theory maintains that logical reasoning is based dually on a person's ability to linguistically understand the problem and on the ability to reference prior knowledge to construct an answer.

The field of logical reasoning studies is broken into two basic research paradigms (Zimmerman & Campillo, 2003). The first seeks to understand logic in formal situations when a participant is presented with a logical problem to solve. The nature of this research is unique in the world of problem-solving as several assumptions must be made by the participant: the logical trial is discrete (has a set time), practice is not inherent in the test, and that the puzzle itself can be fully answered. The second paradigm is that of informal logical reasoning skills. This type of research seeks to understand how individuals reason in real-life situations when clear answers are not present and trial and error are common solutions to a situations that may or may not have a satisfactory answer.

One factor that is common in all research as to how logic works is the importance of the comprehension of the text which encodes the puzzle (Whitten & Graesser, 2003). Text is the gateway to understanding what the puzzle presented is asking the participant

to do. Text has layers to it that are particular to the field of logical reasoning (Whitten & Graesser, 2003) which can prevent an unskilled learner in logic from correctly finding a solution. The other factor in logical research is that most instruments testing logical ability are "homemade" by researchers for a particular research project. Researchers use forms of logical puzzles, such as syllogism and deductive reasoning, to create their instruments for specific purposes in testing theory.

One instrument that has been used across many projects researching logic is the Tower of Hanoi puzzle (Hambrik & Engle, 2003). The importance of the Tower of Hanoi test is that it appears to be fairly independent of linguistic reasoning, so often associated with many logic puzzles constructed by researchers. The Tower of Hanoi and similar logical problems are unique, as their function appears independent of the slave memory systems proposed by Baddeley (Hambrik & Engle, 2003).

Mathematical Reasoning

The difficulty with research involving mathematical reasoning is that most instruments of mathematical reasoning are not solely tests of how an individual processes mathematical functions, but a blend between mathematical reasoning and other types of reasoning such as syllogism, and are thus reasoning tests of a mathematical nature, rather than mathematical reasoning tests (Carroll, 1996). Mathematical reasoning tests examine general reasoning and problem solving skills rather than mathematical reasoning (Carroll, 1996).

Two types of tests exist which counter the typical mathematical reasoning research: number series tests and tests such as Raven's Progressive Matrices test (Raven, 1962). These instruments are designed to test inductive mathematical abilities and do not

rely on participants being able to "figure out" a word problem or a logic problem of a mathematical nature. Carroll (1993, p. 238) argues that inductive tests "Require subjects to inspect a class of stimulus materials...and infer...a common characteristic underlying these materials." Carpenter, et al. (1990) argues that these types of tests are more accurate at indicating mathematical reasoning because the skills used to solve them are what drive the solutions in more complex types of problems.

The body of research surrounding mathematical research appears to verify this opinion. The search pool is heavy in research on how participants solve word problems (Lewis & Mayer, 1987; Mayer & Hegarty, 1993; Verschaffel, De Corte, & Pauwels, 1992), how mathematical errors are made in using algorithms and mathematical processes (Ben-Zeev, 1993; Lewis & Anderson, 1985), cultural differences in mathematical reasoning (Miller & Paredes, 1993; Rogoff, 2003), and other aspects of mathematical reasoning and education. The body of research on memory span and mathematical ability is robust, but research on the problem solving holds the same caveat of testing more general reasoning skills than specifically mathematical skills.

The Bridge between Play and Adolescent Development

It is apparent from casual observation that adolescents do play. They play video games, engage in sporting events, play with younger children, and engage in a variety of other play activities (e.g. skating, football, video games). What has not been researched as of yet are the developmental reasons underlying this type of play. The play theories explain play as it occurs in early and mid-childhood, and the developmental and cognitive theories and research explain much of the behavior of adolescents. What is not apparent is how play and development interact in adolescents.

If Vygotsky's (1976) assertion is correct that play is not motivated solely by enjoyment, but also by developmental reasons, it must be presumed that play in which adolescents engage have a developmental purpose. Research should be conducted to determine what adolescents achieve developmentally through their play.

Adolescents cannot engage in fantasy play as younger children do because it is not socially-acceptable. There must be a mode or method for these teenagers to express this deep-seated desire to play and engage in fantasy. The phenomenon is partially described by Marcia (1966) when he discusses identity formation. Much of what he describes could be attributed to adolescent's engaging in the fantasy play of what it would be like to be a different person or to belong to a particular subculture (e.g. skater, scene-kid, preppy). The engagement in fantasy play may also be the reason that adolescents engage in risky behaviors such as sexual activity and drug use, as this would be a way to "play" at being an adult.

The explanation of these behaviors may be found by extending Vygotsky's theory of play. According to Vygotsky (1976), fantasy play serves as a method of wish fulfillment. What Vygotsky stresses is that fantasy play is not the fulfillment of specific desires, but of generalized affects. In this light, the behaviors of adolescents during the Identity Crisis as described by Marcia (1966), could easily be explained by fantasy play. Adolescents are engaging in forms of play to explore identities by how they dress or interact with adults.

Aside from identity exploration, adolescents still engage in other forms of play. While it may seem that adolescents are participating in Games with Rules (Piaget, 1976c) when they participate in athletics and other socially acceptable games, Vygotsky's (1976)

theory of games can be applied as well. In Vygotsky's theory, all games with rules are fantasy games and all fantasy games are games with rules. Due to the manner in which a person engages in the game, an element of fantasy must be present.

Adolescents who participate in athletics and other games with rules engage in fantasy. Many elements go into the enjoyment of an athletic competition for an adolescent including physical feelings, competition, and personal challenge. However, fantasy is a part of these games as well. Teenagers who engage in these types of games may have a rich fantasy-life related to identity crisis. By playing them, adolescents are engaged in fantasies that could range from merely seeing the game as a competition to be won to imagining themselves as world-class players.

A second source of adolescent engagement in fantasy play is through video games. Prior to the video-game movement in America, teenagers who wished to become involved in fantasy games of this sort had to employ tabletop games such as *Dungeons and Dragons*. However, due to complex rules and the use of highly expressive language, only adolescents with strong determination and high verbal and math skills could participate. Also, participation in *Dungeons and Dragons* (Cook, 1989) carried with it a stigma of being "geeky" or accusations of deviant behaviors such as satanic worship (Chick, 1984; LaFarge, 2006).

The video-game revolution now allows teenagers, particularly boys, to engage in games that allow them to express themselves and to explore a rich fantasy life. Gentile and Gentile (2007) discuss a strong correlation between adolescents' tolerance for violence and the choices they make in video games. They postulate that video games may develop violent tendencies in adolescents; however, they do acquiesce that more

violent teens may choose more violent games. At this time, it is impossible to determine the direction of the correlation.

Given the wide range of choices adolescents now have in video games, they may be choosing games that allow them to better fantasize and explore the general affect of adulthood. Adolescents who choose violent games, such as *Halo* or *Call of Duty*, may not have a general affective desire to hurt people, but rather have a desire to express control over a world that is chaotic or to feel like a hero who saves the day by "blasting the bad guys." Engagement in these types of games are symbolically and functionally the same as early-childhood players playing "Cowboys and Indians" or "War." The popularity of these types of games may indicate that Vygotsky's theory of fantasy play (1976) does expand past late-childhood and that as children turn into teenagers, they do not necessarily internalize play into pure fantasy (1931).

As internet technologies are developing, adolescents are more frequently choosing to engage in fantasy-based games that involve multiple play partners, in some cases hundreds of thousands of partners. This development is also in line with Vygotsky's argument of the development of social play. Adolescents playing in these games negotiate rules and develop social interactions based on the fantasy world created by the video game.

Therefore, the gap between play theories and developmental theories for adolescents needs exploration. If adolescents are engaged in play for developmental reasons that are related to cognitive functions, then Vygotsky's Zone of Proximal Development should be present during a fantasy play state. Much of the instructional research for play has used Istomina's (1975) study into voluntary memory as a basis for

the existence of the Zone of Proximal Development. A replication of Istomina's study would provide a method for examining the phenomenon of play in adolescents.

Istomina's Study

Istomina (1975) was not directly studying play in her classic 1930's study "The Development of Voluntary Memory in Preschool-Age Children." Istomina was searching for the earliest age at which a child could "voluntarily" remember specific facts versus generalized experiences. Istomina understood Leontyev's (1974) concept that young children needed context in order to remember, and she developed her methodology based on that concept. Istomina's study was not complex. She created two groups of children aged three to seven. The first group of children were told a list of five words. A gap of 90 seconds was allowed to elapse and the children were asked to repeat the list of words. After listing the items, the children were asked, "Is there anything else?" The second group engaged in a fantasy situation. The six children were divided into a store group and a school group. The children played at school and one of the children was asked by an adult playing the principal to go to the store to get some items for the class (a similar list as given to the lesson group). The children went to the store part of the room and asked the store manager for the list of items after a lapse of 90 seconds. After giving the manager, played by an adult, the list of items needed for the class, the manager asked, "Is there anything else?" The children rotated different roles between the groups, both standard educational model and play model and roles within the play model. Istomina mixed the order in which the children participated in the conditions (lesson and play) to diminish treatment order effects.

Data were taken in two ways. First, Istomina examined quantitative data. She measured the results of how many responses in each group the children were able to correctly give. She also cross-examined the ages of the children with their responses and the group participation (See Table 1). Aside from quantitative data, Istomina collected qualitative data. She examined how the children responded to the tasks, such as rehearsal (saying the words silently or aloud to themselves) and the types of interactions they had with the adults. This type of data was vital for her study because it demonstrated the affective modes of how the children responded. For example, three year olds would not even listen to the complete list of words before running to the store, while six year olds would generally repeat the list of words to themselves, either orally or silently mouthed.

Table 1

Results from Istomina's Voluntary Memory Study (1975)

Participant Age (Years)	Average Word Recall (Laboratory "Lesson" Setting)	Average Word Recall (Play Setting)
3-4	0.6	1
4-5	1.5	3
5-6	2.0	3.2
6-7	2.3	3.8

Note: The full group participation is N = 60. Each subgroup has n = 15. Adapted from

"The development of voluntary memory in preschool-age children," by Z. Istomina, 1975, *Soviet Psychology*, 13, pp. 5-64.

Istomina isolated the age at which children began to have voluntary memory—age five. She noted at what age children appeared to have a grasp of memory and when they appeared to make a distinction in using mnemonic devices to remember. While the

results that focused on the primary intention of her study were powerful (to determine the age of voluntary memory), the unintended results of her study were more powerful for the research of play.

Istomina's (1975) study gave credibility to Vygotsky's (1978) theory of the Zone of Proximal Development. Istomina found that in the two groups, the children in the play condition did significantly better than those in the lesson condition. Children in the play condition were able to remember more words consistently and rated higher than older children in the educational condition of the study. These findings became the root for most of the future study into play as a method for instruction. However powerful these findings were, the subsequent research that attempts to replicate her findings had mixed results.

Prominent Replications of the Istomina Study

Theoretical Versus Methodological Replications

Istomina's study has been replicated several times in the decades following her original research with differing results (Reese, 1996). Several studies have disproved her findings and several have only partially confirmed them. Reese (1996) suggested that the differences in results are due to differences in theoretical versus methodological replications.

A methodological replication is a replication where the researcher is attempting to obtain the same results as the original research using an "exact" methodology. In this type of research, the researcher will follow the original methodology as closely as possible (Reese, 1996). Methodological replications are valuable as they can build validity to conclusions drawn from research and deflate threats to validity resulting from

replication errors (Mitchel & Jolley, 2007). The problem with this type of research is that most published research does not contain all of the details of the original methodology. Researchers attempting this type of research are often unaware of seemingly small details that may have a great impact on the results of a given study (e.g. time of day a study was conducted).

Theoretical replications are replications where a researcher attempts to test the theory informing an original study (Reese, 1996). Replications in this sense do not necessarily have to follow the exact methodology as the original. In fact, they seek to examine the underlying theory of the original work and to "tweak" the methodology of the new research. Theoretical replications can look much different methodologically; however, they get at the heart of the theory underlying the original research. For example, a theoretical replication of Istomina's (1975) study, looking at the earliest age of voluntary memory, could use a radically different methodology. The children could be asked to replicate a set of tasks while assisting an adult cooking. The basic theory would be tested in a similar method as the original test, but with a radically different external methodology.

Istomina's Replication

Istomina (1953) replicated her own study twice. The replications followed the same procedures as the earlier experiment. The difference between the original study and the first replication was that she used a different set of children from different kindergartens and different examiners. While her findings were not exactly the same as the original study, they were consistent with her original work and validated her findings. Istomina then replicated her study a second time with a change in the methodology of the

study. As seen in Table 2, Istomina in the replication of the original study (1975) began looking at the effects of practice (i.e. having participated in one of the other conditions) on the outcomes of her original research. In the original study and replication, each participant engaged in both conditions. Istomina in the replication study sought to establish if practice in a particular condition increased the likelihood of correct response. In the replication study, Istomina had each participant placed in both conditions, lesson and play. The participant took part in the condition which would be unpracticed first and data were recorded. The participant then engaged in the condition which was to be practiced.

Table 2

*Comparison of Mean Responses of Istomina's Original and Replication Study of**Voluntary Memory (1975)*

Age Range (years)	Experiment	<u>Practice in Game</u>		<u>Practice in Lesson</u>		<u>Combined Groups</u>	
		Lesson	Game	Lesson	Game	Lesson	Game
4.0-4.9	Follow-up	1.5	2.6	1.8	2.5	1.6	2.6
	Replication	1.6	2.8	1.6	2.4	1.6	2.6
5.0-5.9	Follow-up	2.4	3.0	2.4	3.0	2.4	3.0
	Replication	2.4	3.2	2.2	3.0	2.3	3.1
6.0-6.9	Follow-up	3.0	3.4	2.8	3.2	2.9	3.3
	Replication	3.0	3.6	2.8	3.4	2.9	3.5
<u>All Ages</u>	<u>Both</u>	<u>2.3</u>	<u>3.1</u>	<u>3.0</u>	<u>2.9</u>	<u>2.3</u>	<u>3.0</u>

Note: Only relevant data for the comparison are presented from the original study.

Group n = 5, except the All Ages Group where N = 30. Based on Reese (1996)'s table aggregating the data from Istomina (1975, Tables 10-13, 15, and 16, pp. 43, 53, 56, and 57).

Istomina found no significant difference between the groups which were tested following a single practice in a non-related condition (Follow-up Experiment) and those who replicated the same condition (Replication Experiment). What was more compelling were the persistence of differences between lesson and game conditions.

Weissberg and Paris's Replication

The first major study that sought to replicate Istomina's (1975) study was conducted by Weissberg and Paris (1986). The results from this study directly contradicted Istomina's research by showing that children actually performed better in the

context of a lesson than they did in the context of play (See Table 3). Weissberg and Paris's study followed a similar methodology to the original study by Istomina (1975). The study differed from the original study in that Weissberg and Paris made the participation in different conditions clearly random. Istomina (1975) only implied that the order of conditions was random when reporting her findings. A second change was made to the list of words used in the study. In Istomina's (1975) study, different words were used between groups. Weissberg and Paris (1986) felt that different wordlists would create a threat to internal validity when comparing the two groups. They used the same list between treatment groups. The last major change they made to the original study was the idea of context to the word lists. The participants engaged with two different types of lists. One was a series of "foods" and the other was a series of "names." The concept was that children should be able to have a different ability to remember words when within a familiar context (foods).

Table 3

Mean Correct Responses of Children Who Rehearsed in the Weissberg and Paris Study (1986)

Participant Age Recall (Years)	Average Word Recall (Laboratory "Lesson" Setting)	Average Word (Play Setting)
"Foods" Conditions		
3.0-3.9	2.8	2.4
4.1-4.9	3.4	2.8
5.0-5.9	4.1	3.2
6.3-6.9	4.1	4.0
"Names" Conditions		
3.0-3.9	1.2	0.6
4.1-4.9	1.6	1.4
5.0-5.9	2.3	2.0
6.3-6.9	3.3	2.6

Note. Based on Weissberg and Paris (1986, Tables 1 and 2, pp. 1126 and 1127) Each group has an n = 24.

Several explanations have been given (Hasselhorn & Schneider, 1994; Reese, 1996; Schneider & Brun, 1987) as to why Weissberg and Paris were unable to replicate Istomina's results.

Weissberg and Paris (1986) themselves attempted to resolve the discrepancy. The findings clearly show that context gives a child a better opportunity for memory. In this same light, Weissberg and Paris postulated that the activity of memory is related to rehearsal. Weissberg and Paris noted that more children rehearsed in the lesson context and that the rehearsal of words created better memory. They went on to suggest that the

playing activity actually got in the way of memory because children in the game-context would not rehearse as it did not feel like a "lesson." Another explanation may be found through Manuilenko's (1975) research that some children may be over-stimulated by the play context, as demonstrated in "The Spiders and Flies" game and do worse in the play condition.

Schneider and Hasselhorn (1994) remark that the date of Istomina's study is unknown. The difference between children prior to 1948 (the date the Istomina study was originally published) and the children of the early 1980's would be remarkable due to parental involvement, television, and access to education. Reese (1974) noted differences in American school children's performances in cognitive tasks within a short period between 1969 and 1970, and suggested these differences could be related to the advent of educational programs for early childhood learners, such as *Sesame Street*. This cultural change could also explain why more children rehearsed in the Weissberg and Paris (1986) study during the lesson condition.

The second issue is related to the concept of relevancy. In the Istomina study, the children had to have a 'permission slip' to access the store. The use of the permission slip indicates a significant importance of going to the store (Schneider & Hasselhorn, 1994). In Soviet Russia during a period of economic crisis, going to the store had a significance that could not be repeated in the early 1980s in America by closely replicating the methodology employed by the Istomina study.

Oyen and Bebko's Replication

Oyen and Bebko (1996) also attempted to replicate the Istomina (1975) study. Their methodology differed significantly from the original study. In the Oyen and Bebko

study, two different types of play conditions matched with a lesson. The play conditions were endogenous or exogenous. In the endogenous condition, the participants participated in a game and, as a part of the game, the memory task was related to the game itself. In the exogenous condition, the participants participated in a game; however, the memory task was not related to the game. Each of the participants also participated in a lesson condition.

Oyen and Bebko (1996) also made a correction to an assumption of Istomina's original methodology. At the time of the original study, the research into memory decay had not been fully explored. It was assumed that the transfer from short-term memory to working memory took place within a 30-90 second timeframe. This transfer time means that what will "decay" or be lost between short term and working memory will occur within this timeframe. Istomina (1975), following what was known about memory, allowed a 90 second delay between the presentation of information and the recall task following this belief. Since Istomina's original study, further research into the neuroscience of memory transfer between short-term and working memory redefined the concept of the decay period. By the time of the Oyen and Bebko study, it was found that the transfer and interference process occurred within a 10 to 15 second timeframe. Therefore, Oyen and Bebko adjusted the delay between the presentation of the memory task and recall to reflect the current research (1996; See Table 4).

Table 4

Mean Number of Correct Responses in the Oyen and Bebeko Study (1996)

Participant Age (Years)	Average Word Recall (Laboratory "Lesson" Setting)	Average Word Recall (Play Setting)
Endogenous Condition		
4.2-5.2	2.2	1.5
5.2-6.2	2.4	1.6
6.1-7.6	3.2	2.4
Exogenous Condition		
4.2-5.2	2.1	1.6
5.2-6.2	2.5	2.4
6.1-7.6	2.8	2.8

Note. Based on Oyen & Bebeko (1996, Tables 2 and 4, pp. 181 and 183). Each group had an n = 20, per type.

The findings of the study indicate that children did better in the lesson than the play condition. Follow-up studies and data analysis found that the lesson context was significant only when compared to the endogenous condition (Reese, 1986). Because of the clearly different methodology, it is difficult to say whether the research conducted by Oyen and Bebeko (1996) support or discredit Istomina's (1975) original study. The findings are more in line with Weissberg & Paris's (1986) findings. This research seems to support the assertion of Weissberg and Paris that the game aspect of the play condition may distract participants from remembering correctly. Oyen and Bebeko (1996) reported a higher percentage of rehearsal in the game conditions than in the lesson conditions, which contradicts Weissberg and Paris's conclusion that the game may distract from

rehearsal. It cannot be determine if the game really prevented rehearsal because Oyen and Bebkco do not report where the percentage of rehearsal occurs (endogenous condition versus exogenous condition). Knowledge about this difference could serve to illuminate the role of play and the use of rehearsal.

Schneider and Brun's Replication

Schneider and Brun (1987) were able to replicate Istomina's (1975) study successfully with a double replication performed in Germany. They made some modifications to the Istomina study, like Weissberg and Paris (1986), such as normalizing the lists of words. The main difference is that Schneider and Brun (1987) noticed that Istomina allowed the children a second prompt at memory retention (i.e. "Is there anything else?"). They felt that such an addition confounded the results of a pure trial related to memory; therefore, they ran the experiment twice. In the first instance, the children were allowed a prompt, and in the second, a prompt was eliminated; however, if a child spontaneously asked for a re-prompt, it was given. Schneider and Brun found that the results of the Istomina study were replicated when a prompt was allowed and no that significant differences between the lesson and play contexts existed when a prompt was eliminated (See Table 5).

Table 5

Mean Numbers of Correct Responses in the Schneider and Brun Study (1987)

Participant Age (Years)	Average Word Recall (Laboratory "Lesson" Setting)	Average Word Recall (Play Setting)
Re-Presentation Condition		
3.8-4.6	1.6	2.9
5.5-6.5	3.0	3.3
Non-Presentation Condition		
3.8-4.6	1.6	2.1
5.5-6.5	2.5	3.8

Note. Based on Schneider and Brun (1987, Table 1, p. 338, and text, p. 337). The sample size is $n = 30$ for each of the age subgroups.

Reese (1996) contends that the replication's results are questionable when compared to the original study (Istomina, 1975). The Schneider and Brun (1987) study had a different range of child ages and differing numbers of items on the lists presented to the children. These confounding variables make it difficult to determine if the results are truly comparable and an authentic replication was achieved.

There may be a connection between the re-presentation of the "is there anything else?" prompt and the theory of Weissberg and Paris (1986) relating to rehearsal. The re-prompting may serve a similar function as rehearsal in how memory works in children, but further studies would have to be conducted to test the hypothesis.

Hasselhorn and Schneider's Replication

Hasselhorn and Schneider (1994) reexamined Schneider's (Schneider & Brun, 1987) original replication of the Istomina (1975) study. The difference with the new study was that they examined item attractiveness as it related to memory. The list of items in the "attractive" conditions of lesson of play included items that a child of the age group would desire or have an interest. The experiment was completed twice (See Table 6).

Table 6

Total Numbers of Correct Responses in the Hasselhorn and Schneider Study (1987)

Participant Age (Years)	Total Word Recall (Laboratory "Lesson" Setting)	Total Word Recall (Play Setting)
Experiment 1- Attractive Items		
4	45	63
6	59	70
Experiment 1- Unattractive Items		
4	43	48
6	56	58
Experiment 2- Attractive Items		
4	39	34
6	55	55
Experiment 2- Unattractive Items		
4	7	29
6	15	27

Note. Based on Schneider and Hasselhorn (1994, Figs. 9-1 and 9-2, pp. 196, 199). The first experiment had an $n = 16$ for each age group and the second an $n = 28$ for each age group.

The results of the new experiments suggested that the play context was more powerful for the ability of young children to remember words, only with items which held attractiveness to the child. These findings were consistent across both experimental trials.

This finding may relate directly to the failings of the Weissberg and Paris (1986) study. Accordingly, Istomina's (1975) study was attractive to the children because of the cultural context of the importance of going to the store in Soviet Russia during a time of famine and drought. This feeling of importance would have lent attractiveness to all the items on the list as the entire task was attractive within the play context. The nature of attractiveness also relates to Vygotsky's theory of wish-fulfillment. The children participating in the original game context of Istomina's (1975) study were engaged in wish fulfillment because they were pretending to be responsible adults. The children participating in the Hasselhorn and Schneider (1994) study may have been engaged in the same process because attractive items on the list may have somehow activated wish-fulfillment and fantasy.

A larger issue with the Hasselhorn and Schneider (1994) study's results exists. In reviewing the tapes and interviewing the examiners, they found that the affect of the examiners changed depending upon the contexts. In the lesson context, the examiners tended to be aloof and cold, while in the play context they were warm and friendly. Because of the internal threat to validity of experimenter effect, it is difficult to determine if the results were due to the affect of the examiner or the actual testing condition. Also confounding the study is a lack of precise description of an attractive versus unattractive item. It is implied that attractive items are objects that a child would like to engage with, such as toys. Newman (1990) created a similar study to the Hasselhorn and Schneider (1994) study with minor differences in methodology. Newman's (1990) work found that children still performed better in the play condition with attractive objects, but only if the attractive object was tangible (rather than a drawing of the object).

Summary of Replication Strategies of the Istomina Study

The replications (Hasselhorn and Schneider, 1994; Oyen & Bebko, 1996; Schneider & Brun, 1986; Weissberg & Paris, 1986) have shown that certain considerations have to be taken in re-creating the Istomina (1975) study, particularly a replication that seeks to generalize to adolescents. The first is the impact of the experimenter in applying the contexts. Care must be taken to ensure that the play context is friendly and warm and not distant. Conversely, the instruction context needs to be warm and friendly, as a cold and distant affect in either treatment could taint the results (Hasselhorn & Schneider, 1994).

A second issue that needs to be addressed is treatment groups. For Istomina (1975), and the replications of her study, she used the same children in both groups. While it is alluded to in her study (1974), and made explicit in others (Weissberg & Paris, 1986), the order of treatments is vital. While it is understandable that because of small sample sizes it was necessary in these studies to use children in both groups, a larger sample allows a researcher to place a participant into a single group and to aggregate the data from the larger sample to determine differences in outcomes. Weissberg and Paris (1986) may have inadvertently created treatment order effects by trying to improve Istomina's (1975) original work. Weissberg and Paris (1986) "corrected" Istomina's (1975) study by having the same words in either group, rather than similar words. By using the same words rather than similar words, a test/retest threat to validity may have been created. Again, using different participants for each treatment group with a larger sample size would correct this effect.

A third major issue revealed by the replications is the need for relevance (Hasselhorn & Schneider, 1994; Reese, 1996) for those being tested. A game context for participants then would have to relate somehow and be important for them. Smirnov and Zinchenko (1969) and Lave (1985) also did work with play contexts and found that the play context is not as important as the relevancy of the play context to the learner. Real life contexts were more important than play contexts in both studies. However, if looking at the theoretical underpinnings of both Piaget (1976c) and Vygotsky (1976) this would be logical as play is a precursor for developmental skills which are real-life. A true replication of going to the store, as in the Istomina (1975) study would not be effective because while it is a real-life situation, it does not hold significant importance for a teenager in modern America in the same way as it would for a child in Soviet Russia during a famine. An updated methodology would include a game that holds particular relevance for American participants, particularly teenagers within a particular cultural group (such as planning an important party).

Another issue with both Istomina's study and its replications is that none of them reflect current research into memory constructs. A replication of Istomina's study should take into account new discoveries related to memory that would reduce threats to internal validity, such as word length effect (Baddeley, Thomson, & Buchanan, 1975), irrelevant speech (Colle & Welsh, 1976), the phonological similarity effect (Baddeley, 1966; Conrad & Hull, 1964; Gupta, Lipinski & Aktunc, 2005; Li, Schweickert, & Gandour, 2000), and the semantics effect (Copeland & Radvansky, 2001; Hulme, Maughan, & Brown, 1991). To take into account all of these different effects, the wordlist and testing environment would have to be highly controlled.

The final major issue that needs to be addressed with Istomina's study is the limitations on how memory was constructed. The original test was valid for looking at voluntary memory as a function of short-term memory. Istomina's research has been used as a platform to demonstrate the superiority of play learning versus traditional presentation of material. Yet research (Baddeley, 1986, 1992, 2000; Baddeley & Hitch, 1974) has shown that the relationship between short-term memory and learning is not direct. Rather, other systems may be in effect, namely working memory. A replication of Istomina's study looking at the relationship between cognitive processing and play would retain the original short-term memory aspect of her test and the general methodology of having two separate testing groups in a play and work condition; however, it would also examine different aspects of cognition rather than simply short-term memory.

Figure 1: Chart Summarizing Istomina's (1975) Study and Replications

Author(s)	Year	Participants	Design Change	Major Findings	Secondary Findings	Limitations
Istomina (original study)	(circa 1930)	Ages 2-7 N=60 n=15	N/A	Voluntary Memory Occurs at Age 5	Children in play treatment conditions score higher than in "work" treatment conditions.	Limited subject size. Doubling of participants in each condition could create treatment order effects.
Istomina	(circa 1930)	Ages 2-7 N=60 n=15	Different group of subjects and experimenters.	Voluntary Memory Occurs at Age 5.	Children in play treatment conditions score higher than in "work" treatment conditions.	Limited subject size. Doubling of participants in each condition could create treatment order effects.
Manuilenko	1975	Not reported.	Children were asked to perform tasks as related to a game called, "Spiders and Flies" or in a regular work condition.	Children perform academic tasks better in a work setting than a play setting.	If a fantasy game is too "intense" it can become a distracter from performance.	The research only sheds light onto the reasons behind the findings of replications of Istomina's study as it is not a true replication.
Weissberg and Paris	1986	Ages 3-7 N=52 n=24	Participation in each group was clearly randomized. Word lists for each group were different. Two sets of words "foods" and "names" were introduced.	Children perform better in a work condition than a play condition.	Rehearsal techniques used by subjects may have an effect on performance.	The culture of American 1986s is too different for a replication of a study done in 1930's Soviet Russia to be accurate. The play task may not have been relevant to the subjects.
Schneider and Brun	1986	Ages 4-7 N=160 n=30	Prompts were eliminated in the second trial group.	Children perform better in a play condition than a work condition.	Re-presentation of prompts increases memory in the play condition.	Different age ranges than the original study.
Newman	1990	Not reported.	Word groups were sorted by desirability to the subjects.	Children perform better in a play condition than in a work condition.	Children only perform better in the play condition when the words on the list are tangible rather than abstract.	The research only sheds light onto the reasons behind the findings of replications of Istomina's study as it is not a true replication.
Hasselhorn and Schneider	1994	Ages 4-6 Experiment 1: N=128 n=16 Experiment 2: N=224 n=28	Word groups were sorted by desirability to the subjects.	Children perform better in a play condition than in a work condition.	Children perform better in the play condition when the words on the list relate to items the subjects desire.	Experimenter effects. Performance of subjects varied by how the researchers presented the material.
Oyen and Beeko	1996	Ages 4-8 N=240 n=20	Play tasks were created to be endogenous (related to the game) or exogenous (unrelated to the game). Memory decay time was reduced from 90 seconds to 10-15 seconds.	Children perform better in a work condition than a play condition.	The work condition is only significant when compared to an endogenous condition. Manuilenko's idea of over-stimulation may be in play.	The methods may be too different than the original study to compare.

The Gap in the Literature

The current extant literature on play related to development, instruction, and cognition in children is extensive. The literature suggests that children have developmental needs that are satisfied through play. Researchers have found that this developmental need can be instrumental in instruction because one of the foundational drives for play is found in cognitive development.

Further, it has been shown that adolescents are continuing the developmental processes started in childhood. The nature of this development is different than of childhood, yet new research into neurological development of adolescents shows that adolescents are still developing cognitively. This development is related to cognitive skills, emotional controls, and identity formation.

What is not known is whether play continues to affect adolescent development in the way that it does for children. The key question that the current extant literature does not answer is: would play continue to affect adolescent development, particularly in the domain of cognition?

This study filled this gap in the literature by using one of the earliest studies into play and cognition for children as a base, while employing the body of replications as a guide to correct for limitations in the original study and tailoring the study for the current population being tested: adolescents.

CHAPTER 3 METHODS

The methods used in this research study were a theoretical replication of Istomina's (1975) study. The methods did not test the original study's findings nor attempt to replicate those findings as they were related to the discovery of voluntary memory. Rather, this study used a similar methodology to test the secondary findings of the study which lent credence to the theory that the children performed memory tasks better in a play condition than in a work condition. The methods used the findings of Istomina's study (1975) to correct for threats to validity in the original study (Hasselhorn & Schneider, 1994; Oyen & Bebko, 1996; Reese, 1996; Schneider & Brun, 1986; Weissberg & Paris, 1986) and, to be culturally relevant to a modern adolescent population employed a computer program and game related to the current cultural discussion in adolescence.

Overview

A theoretical replication does not attempt to follow the exact methodology of an original study. Rather, it examines the theory that the original study tested, then creates a new methodology to test the theory in an approximate manner for a different population (Reese, 1996). Often, the theoretical replication has similar methods; however, because the new study is for a different population, it may appear radically different. The point is not to test the validity of the original methods, but the theory. Some methods which are appropriate for one population may not apply to another, particularly when participant age, culture, or gender is different.

Because the population of this study is different in several dimensions from the original study, both in age and culture, a theoretical replication is most appropriate for

this study. The study shares the basic characteristics of the original, namely two treatment groups which divide the participants into a work or play condition and the testing of cognitive (including memory) skills in each of the conditions.

Research Questions

The research questions for this study are as follows:

1. To what extent do adolescents perform basic cognitive tasks, specifically memory, reading, logical reasoning, and mathematical reasoning skills, differently during fantasy play situations than in instructional situations?
2. Is there a difference in the age group of the adolescent (middle: 14-16; late: 17-19) and how basic cognitive tasks, specifically memory, reading, logical reasoning, and mathematical reasoning skills, are performed during fantasy play situations?
3. Do adolescents' age, socio-economic status, and overall academic performance predict their cognitive skills in memory, reading, logical reasoning, and mathematical reasoning during fantasy play situations vs. instructional situations, respectively?

Research Hypotheses

The hypotheses for the research questions are:

1. Adolescents will perform the basic cognitive task of memory better in fantasy play situations than they will in instructional sessions, specifically in the domains of memory, reading, logical reasoning, and mathematical reasoning skills.

The hypothesis is derived from the history of the replications of Istomina's

(1975) original study. The trend in the data is that, if modifications are made to the methodology to make the items in the memory task attractive or important to the participant, the play condition will provide better performance (Hasselhorn & Schneider, 1994; Newman, 1990). This study attempted to make the items in the play condition relevant to the participants by using a cultural context in the fantasy game. The items (food) would not normally be attractive to the participants, but the desire to win the game gives immediate relevance to the participants, as the game is designed to be culturally important to the participants. Also, more cognitive skills were tested in this study to accommodate the expanded understanding of development of adolescents.

2. No differences exist between the play condition and the work condition in the basic cognitive tasks of memory, reading, logical reasoning, and mathematical reasoning skills between the two tested age groups (14-16 and 17-19).

This hypothesis is made by combining Vygotsky's theory of the Zone of Proximal Development (1976) and the current research into working memory (Sousa, 2005). Sousa (2005) notes that certain age groups have different memory capabilities. In early memory development (ages 5-13) the number of items that can be stored in working memory is smaller than during later memory development (age 14 and older). The average number an early adolescent can store in working memory is five items. The next stage of development, the average number of items, seven, becomes permanent through adulthood.

If Vygotsky is correct about play acting as a facilitator to the Zone of Proximal Development (1976), which has been validated by research (Hall, 1991; Istomina, 1975; Kitson, 2005; Rowe, 2000; Williamson and Silvern, 1991), then an early-adolescent

learner (age 12-13) will be able to access the Zone of Proximal Development and perform at the next level of cognitive development. This logic can be extended beyond just memory into the other cognitive domains as well. Older age groups may perform better as well, yet at this time no research suggests that the Zone of Proximal Development pertains to them.

3. Adolescents' age, socio-economic status, and overall academic performance predict their cognitive skills in memory, reading, logical reasoning, and mathematical reasoning during fantasy play situations vs. instructional situations respectively.

The review of the literature suggests that within the different treatment groups, the factors that will have the highest significance on performance of cognitive tasks include age, socio-economic status, and overall academic performance (Eamon, 2005; Kitson, 2005; Similansky, 1990; Sousa, 2005). In the previous replications of Istomina's (1975) study, no differences appeared in gender and performance in early childhood participants; however, age was a primary factor in performance. As the memory studies have shown (Sousa, 2005), division exists in memory performance between ages, regardless of gender. Therefore, age was the primary factor in determining performance differences.

In Similanski's (1990) research into early-childhood development, she found that economic-status had an effect on how children interact with each other and play. She found that children from higher-economic status homes interacted better in play situations and demonstrated more positive social characteristics. Her research found that through play, children of lower-economic status could learn these skills and apply them

to an educational environment. She also found in her research (1990) a relationship between academic performance and play. Children who played better also performed better on academic tasks. It is plausible that these basic social facts of play in early-childhood have life-long implications and will be equally relevant in the play of adolescents.

Research Design

This study is a quantitative experimental group comparison design with qualitative elements (Mitchell & Jolley, 2007). Two groups of participants were tested: a control (the work condition) and a treatment (the play condition) condition. The independent variable was participation in the play condition while performing cognitive tasks in memory, reading, logic, and mathematics. The dependent variable was adolescents' cognitive performance indicated as the number of correct items answered and the time taken by the participants for each cognitive test in each condition. The qualitative element of the design was a series of open-ended questions about the participants' feelings during the experiment.

Sample Information

The importance of random sampling is that it diminishes several threats to internal validity (Mitchell & Jolley, 2007), but random sampling is not a panacea that removes all threats to internal validity (McMillan, 2007). Random sampling allows the researcher to have power in the effect of the treatment. Without random sampling, differences between the treatment and control could be due to bias in the sample caused by between-group individual differences. Two groups that are homogenous in important dimensions

can give the same power to a researcher with minimal threats to internal validity (Mitchell & Jolley, 2007).

For the purposes of this study, a purposive cluster sample was collected by asking all of the students in a particular grade at the participating schools if they wished to participate. The participants were drawn from three Catholic schools in an urban mid-Atlantic state. One of these schools was a coeducational primary and primary/middle school (k-8) and two are single-sex high schools (9-12), male and female respectively. The participants from these schools have similar backgrounds on important personal characteristics. Many have gone to school together their whole lives and share backgrounds in culture, socio-economic status, and race. The participants have a typically Catholic-Christian moral grounding due to mandatory participation in these schools in religious education and home catechesis overseen by a single organization (a diocese). The majority of the participants were white-Caucasians who belonged to the middle-to-upper-middle class socio-economic status, that is belonging to the top-half to third-percentage of ownership and parental educational backgrounds (college educated). In order to ensure the demographics of the sample were homogenous, questions relating to demographics of race and ethnicity, socio-economic status, general academic performance and ethnicity were asked at the beginning of the administered test. Due to the independent nature of the schools, standardized test information was not available to use in drawing conclusions about the academic performance of the sample, but a question relating to general academic performance was asked (i.e. GPA). Also in the cognitive tasks of memory, reading skills, logical reasoning, and mathematical reasoning, performance is generally consistent across populations (Sousa, 2005). The demographic

information was analyzed using tests for variance and the Chi Square Test for Homogeneity where applicable.

The sample size of the study was $N = 202$. Each subgroup had an $n \geq 15$. The samples were divided into subgroups to test particular interactions with the treatment condition. Three groupings based on age (early: 12-13; middle: 14-16; late: 17-19) were determined by looking at memory research (Sousa, 2005), developmental stages (Erikson, 1991; Marcia, 1966; Muuss, 1991), and ease of grouping students by grades for the schools participating in the study-7th and 8th grade: ages 12-13; 9th and 10th grade: ages 14-16; and 12th grade: ages 17-19.

Placement into the control or treatment condition was random. When the participants entered their personal information as a part of the initial part of the study (i.e. demographic information and IRB Assent Document.), the computer used a random number generator to determine the condition in which the participant took part. If the number drawn for the participant was even, a play condition was given, and if the number was odd, a work condition was presented. Due to probability, participation in each condition was approximately random.

Participant Information

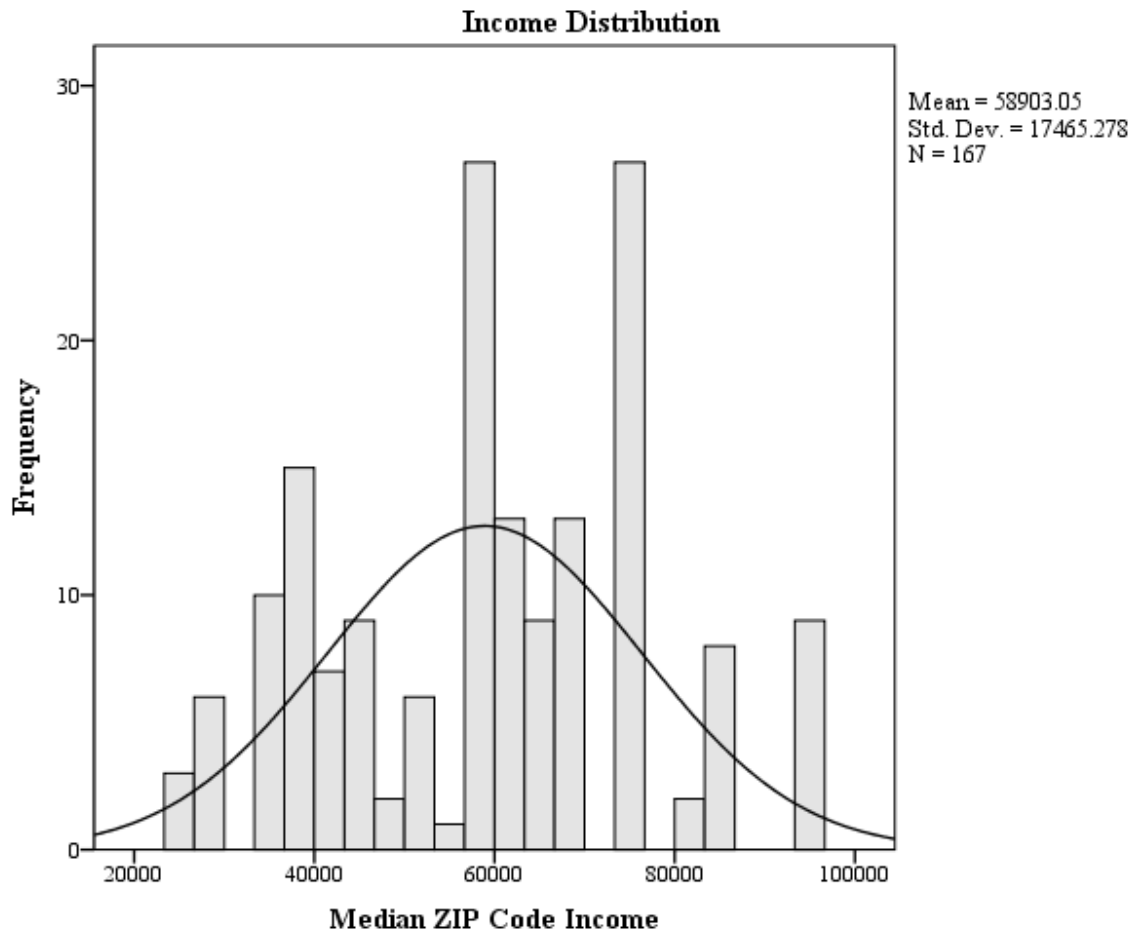
Information relating to the population sampled was collected. This information included age, ZIP code, race/ethnicity, and general academic performance. This information was collected to determine the homogeneity of the population. The information was organized and compared using descriptive statistical measures and a Chi-Square Test for Homogeneity. The data presented on population characteristics only relate to the all-male high school because the data collected from the other two schools

were unusable for answering the research questions. The population data, therefore, only reflect the population whose data were used to answer the research questions.

The first information category described is age. The participants had an option of three age groups to select (early: 12-13; middle: 14-16; late: 17-19). In the final analysis, the lowest age group was dropped since the data from the middle school were unusable. The total number of participants was N=167. Of these participants, 62% reported being 14-16 and 38% reported being 17-19.

The second information category presented is socio-economic status. In order to determine socio-economic status, the participants were asked for their ZIP codes. The ZIP codes were then used to determine the median income of the participant's neighborhood. The median income range is reported with a histogram in order to show the distribution and range of the population's median income. A normal distribution curve was placed over the histogram to demonstrate deviation from the normal curve (See Figure 2).

Figure 2: Median Income Distribution



The median information was coded into income brackets. These income brackets represent a general socio-economic status. These brackets were set in increments of \$25,000 in order to give a general sense of socio-economic status of the population. Due to the fact none of the participants responded as having a ZIP code representing less than \$25,000, that bracket is not reported or used for data analysis. The total number of participants was N=167. Of these participants, 31% belonged to a household with an average income of \$25,000-\$50,000; 57% belonged to a household with an average income of \$50,000-\$75,000; and 12% belonged to a household with an average income that was greater than \$75,000.

Race and ethnicity data were also taken from the sample. The participants had several choices to select from as well as an option to select "other" or not to respond (See Table 7).

Table 7

Race and Ethnicity of Sampled Population

Race and Ethnic Group	n	%
White	132	79
African-American	22	13
Latino	4	2
Asian	1	1
Other	6	4
No Response	2	1

Note: N=167

The last type of demographic data reported related to the general academic performance of the population. Since the population attends a private school, data from standardized tests could not be obtained. Instead, a self-reported sample of general academic performance was taken (see Table 8). Participants were also given the option of not reporting their performance.

Table 8

Self-Reported General Academic Performance of Sampled Population

GPA	n	%
1.9 or Less	4	2
2.0-2.49	13	7
2.5-.2.9	28	17
3.0-3.49	52	31
3.5-4.0	56	35
No Response	14	8

Note: N=167

Chi-Square Tests for Homogeneity could only be conducted on data relating to socio-economic status. Data relating to the other two background domains— race and ethnicity and general academic performance—did not meet the statistical assumptions for a Chi-Square test to be conducted, namely not having at least five responses in each cell (e.g. in race and ethnicity, one response for the "Asian" category). However, even with a lack of testing, homogeneity appears in the population from the descriptive statistical data.

The Chi-Square Test for Homogeneity conducted with the data relating to socio-economic status (See Table 9). One of the selections for the participants, income of less than \$25,000, was dropped from the Test for Homogeneity because the absence of data for that cell. It can be reasoned that the cell could also be dropped because the lack of data for the cell indicates a type of homogeneity in the other cells.

Table 9

Chi-Square Test for Homogeneity for Socio-Economic Status

	Observed N	Expected N	Residual
\$25k-\$50k	52	57.7	-3.7
\$50k-\$75k	96	57.7	40.3
\$75k or More	19	57.7	-36.7

Note: N=167

The Chi-Square Test for Homogeneity found a statistically significant cell. The percentage of participants that differed by socio-economic status was significant, $\chi^2(2, N = 167) = 53.62, p < .01$.

While the Chi-Square Test for Homogeneity appears to have found that the population is not homogenous in nature, it does indicate that the differences are not that extreme. The test results mirrors the descriptive statistics. When examining both results together, it is evident that the socio-economic status clusters around two points within the middle cell. The clusters are at the higher and lower end of the middle cell, with many of the participants not being placed in the middle cell due to rounding. These findings are in-line with the nature of the school . Because the school is private, two main socio-economic groupings were present in the school—students placed by their own parents' economic means and those who are placed there by school scholarship.

Treatment Conditions

McMillan (2008) has remarked that the term treatment and control are misnomers as each group participates in a type of treatment, even if one is a lack of treatment. For this study, one group participated in a control condition based on a standard presentation

of cognitive tasks, while the other group had the same presentation of tasks, but embedded within a fantasy game.

The overall methodology of the study attempted to replicate Istomina's (1975) research while compensating for some of the drawbacks to the other replications. The first major change was the medium of presentation. It is developmentally-inappropriate to ask an adolescent to engage in the same type of play as an early-childhood learner. Computerized games are an acceptable medium for adolescents to engage in fantasy play as they allow them to develop a personal and hidden fantasy life (Gee, 2003).

To compensate for the effect of having one treatment done in a computerized medium and the other not, both groups—control and treatment—used the computer to participate in the study. The use of the computer compensates for another issue with replications of the methodology of the Istomina (1975) study. Schneider and Brun (1986) discovered in their replication that with this type of methodology, experimenter effects are prevalent. In reviewing the tapes of their study, they found that experimenters in the work condition generally acted aloof and cold to the children, while in the treatment or play condition were friendly and warm. The use of a computer removed the potential of this threat.

The final adjustment had to do with cultural relevance. In the 21st Century, the idea about what is relevant to an adolescent has changed drastically since Oyen and Bebeko (1996)'s last major replication of Istomina's (1975) study. The original concept of pretending to shop for groceries does not hold much relevance to teenagers. Using a computerized medium, in part, gave the study cultural relevance. The video game which incorporates the cognitive tests was designed to match current cultural themes and

discourse in the adolescent culture. While the words themselves may not be culturally relevant or desirable to the adolescent—which has been noted as being important to having the play condition create the Zone of Proximal Development (Hasselhorn & Schneider, 1994; Newman, 1990; Oyen & Bebeko, 1996), the play condition should have created the relevance needed for the words to have the same effect. It could be argued that because of the cultural importance of going to the store in Soviet Russia, the items presented in Istomina's original study (1975) became attractive (Reese, 1996).

In order to examine the engagement of participants in a play condition, a qualitative element was added to the overall study. At the end of both conditions: work and play, a series of open- and closed-ended questions were presented to the participants (See Appendices L and K). The close-ended questions are directly tied to the definition of play given by Gray (2009). The purpose of the questions was to determine if the participant was actually engaged in a fantasy play situation.

Design of the Work Condition

The participants began the study by being given oral and written directions to open a web-browser and type in a URL by which the participants were directed to a screen from which they entered into the study. A set of questions was asked to determine that the participant met the Virginia Commonwealth University Institutional Review Board requirements for assent in participation in the study (see Appendix A). The participant then answered several basic information questions with corresponding choices (see Appendix B). These questions were designed to test the homogeneity of the participant with other participants in the study and gain basic data used for research purposes.

After the participants entered the information, their data were tagged with an identification number.

Cognitive Tests

The four cognitive tests relate to memory, reading, logical reasoning, and mathematical reasoning. Memory was chosen as a cognitive test because it is the principal cognitive aspect explored in the original study (Istomina, 1975) and in the replications (Reese, 1996). Memory is an important cognitive function to examine as it is the basis of learning (Sousa, 2005). The other three cognitive domains were chosen because of their relevance to education and learning (Sousa, 2005). While not as fundamental to the learning process as memory, the other three functions are considered to be basic learning skills. All of the tests given in this study were developed specifically for this study by the researcher.

Memory Test

The memory test followed the same basic procedure as the Istomina (1975) study. The test began with the participants being informed of the format of the test (e.g. number of items, interference time, etc.) The screen presented eleven food items, one at a time. The selected words were common food items (e.g. onion and yogurt), as the test is designed to test memory, not memory of new items. Eleven items are presented as nine is the upper limit of what adults are able to hold in short-term memory (Miller, 1956). Eleven items were chosen in order to avoid ceiling effects. As each item is presented, the previous item was removed from the screen rather than having all of the items presented at once. This presentation was done to emulate the procedure of the original study where children were presented the items orally. The participants were asked if they wished the

items to be represented once more. Again, this step is done to replicate the original methodology.

Another adjustment made to this study from the original was the use of the words. Following the recommendation of Weissberg and Paris (1986), both the control and the treatment groups had the same list of words. Unlike the Istomina (1953, 1975) or Weissberg and Paris (1986) studies, the participants did not take part in both conditions. The isolation of the participants into a single condition allowed for the elimination of the internal threat to validity caused by use of different words and at the same time eliminated the treatment order effect which may have been present in the Weissberg and Paris (1986) study. The items presented were designed to compensate for potential errors in Istomina's study (1975). The items (see Appendix C) were adjusted to reflect the current research in memory. Each of the words had the same syllabic length and articulation duration, as these differences can cause irregularities in which words are retained in memory (Baddeley, Thompson, & Buchmann, 1975). The words were also adjusted for phonological similarity (Hulme, Maughan, & Brown, 1991). Each of the words was distinct in sound and avoid alliteration and rhyme. To avoid lexicality (Hulme, Maughan, & Brown, 1991) from interfering with the test and giving certain individuals a higher chance of memorizing the items due to prior experience, all of the words were common food items. Also, by having all of the items from a common group, the items did not overtly chunk into smaller groupings; however, a savvy participant could still potentially chunk items (e.g. by food type or classification).

After the items were presented or represented, a screen showing an image of a wheel moving appeared for 15 seconds. The wheel screen was to allow for interference,

allowing items to be forgotten from short-term memory. Given recent research into short-term memory, which informed the corrections that Oyen and Bebeko (1996) made to Istomina's (1975) study, 15 seconds was established as a reasonable interference time. Having a shorter and more consistent time controls the time the participants can rehearse. In the original Istomina (1975) study, the participants walked from one room to another before reciting the list of words. During this time participants could rehearse or become distracted. The wheel was added in order to compensate for early termination of the test or for confusion of a participant feeling that the program was "stuck" as a purely blank screen would have done. Another advantage of having the test conducted through an electronic medium is that it reduced irrelevant speech (Colle & Welsh, 1979) as a potential for increased forgetting during the interference phase. The background noise of other participants playing or talking would interfere with how much is remembered and the results would depend on the participant's ability to focus rather than remember.

When the interference period ended, the participants were presented with directions to enter as many items as they remembered by typing into a blank box. Only one box was presented at a time and an option to finish was always present on the screen. Again, the single box for entering the response is to recreate the original study as closely as possible. After the participants finished typing the responses and indicated that they were finished, the program asked them, "Is there anything else?" This element was added to replicate Istomina's (1975) work and to incorporate Weissberg and Paris's (1986) finding that without prompting, participants do not perform as well.

The data given by the participants were immediately collected into the server. Correct responses were calculated on a yes/no criterion. Incorrect responses were tagged

for manual inspection and correction. The collection of data through typing is an approximation to verbal responding in the original Istomina study (1975). Since the responses are typed, some responses are correct, yet misspelled. The computer was not able to discern that information as it was limited to exact responses. By correcting the data, the research maintained the replication and corrected for the threat to validity caused by the medium of a computer rejecting correct responses, but marked incorrect due to spelling.

Reading Comprehension Test

The reading test began by the participants being informed that they would take a reading test, by being given the parameters of the test (e.g. format and presentation), and by being given a computerized form of the Daneman and Carpenter (1980) Reading Span Test developed by van den Noort, et al. (2008).

The Reading Span Test was developed by Daneman and Carpenter (1980) not to test reading comprehension, but working memory within the phonological loop. The theory behind the test was that memory tests for working memory did not actually replicate the processes of memory within a real-life context (Daneman & Carpenter, 1980). The Reading Span Test attempts to test this working memory by asking the participant both to remember and comprehend at the same time, a function theorized to exist during actual reading comprehension. The purpose of this kind of testing was to help identify and diagnose diseases which affect cognitive processing, such as dyslexia and Alzheimer's disease.

In the original test, participants were shown sentences on cards, followed by a blank card to indicate that they were to repeat the final word in each sentence presented.

The first trial began with a pair of sentences, and the number of sentences was increased until the participant could no longer correctly remember all of the words presented. The number of correctly remembered items was the "reading span" or size of the participant's working memory.

The original test contained serious flaws which potentially led to problems for researchers using the test. The major flaws were: (1) the lengths of the sentences varied in syllables and letters, meaning that sentences of equal word-length had different actual lengths; (2) the lengths of final words in sentences varied (Tehan, Hendry, & Kocinsky, 2001), which can affect how well they are remembered (Baddeley, Thomson, & Buchanan, 1975); (3) the original test contained variations of the final words were common or uncommon (Baddeley, 1997); (4) control as to whether the final words in the series were abstract or concrete was not present (Kondo & Osaka, 2004) which can lead to issues as abstract and concrete words use differing memory strategies (Baddeley, 1986); (5) because the original test used cards, no control existed for the amount of time a participant was allowed to read (Friedman & Miyake, 2004), which can improve recall as reading strategies are implemented (Saito & Miyake, 2003); (6) the original test only looked at the longest set of sentences that a participant could recall—not an accurate assessment of working memory (Desmette et al., 1995) —rather than giving a rating based on the entire amount of words remembered which would yield a more accurate assessment (van den Noort, et al., 2008).

The van den Noort et al. (2008) test sought to correct these methodological problems. The test normalized the lengths of sentences through syllables, words, and numbers of letters. The test also presented final words which were common in the

language of the participant. All the final words were changed to be concrete and not a mixture of abstract and concrete. By using a computerized medium the test allows a maximum of 6.5 seconds per sentence to control for reading strategy effects. The final change was to semantic relationship in order to prevent chunking within working memory. The set sizes were also changed to be longer than the original test to prevent participants from creating ceiling effects (see Appendix D).

The test was first developed using first a plausibility test with 120 student participants. It included 100 potential sentences for the test and 20 distracters to determine the validity of the potential items. The test was then piloted using 40 students (ten for each language the test was developed for). The mean reading time for the English version was 4042 ms (SD=195.1). The final test was compared to other tests of working memory, namely a digit span test and a letter-number ordering test, both derived from the Weschsler Adult Intelligence Scale (WAIS-III) (Weschler, 2000). The final study comprised of 160 undergraduates with 40 participants in each native language. The participants completed the battery of tests and were then retested two weeks later to determine test-retest reliability. A Pearson's correlation found a significant correlation between the developed instrument and the digit-letter ordering test of working memory ($r=.58$, $p<.01$), but not the digit span test. The internal consistency of the items resulted in a Cronbach's α of .92. The test-retest reliability was confirmed with a Spearman-Brown coefficient ($\alpha = .88$).

The van den Noort (2008) Reading Span Test was a good test for comprehension as the original Reading Span Test correlated highly with reading comprehension tests, particularly high Pronoun Reference and Factual Recall and moderately high with SAT

reading comprehension (Barr, Kamil, Mosenthal, 1996). While the new test has not been directly tested with these measures of comprehension, the changes made by van den Noort would not significantly affect the elements relating to comprehension, but serve only to tighten criticisms which would weaken the theoretical correlation between the Reading Span Test and comprehension.

The test presented made some adjustments to the van den Noort (2008) Reading Span Test. The original test called for the participant to read the sentences orally and state the final words to a researcher. In this study, the reading skill used was slightly different. The participants were asked to read the sentences silently and respond by typing. In order to prevent confusion, at the response screen, a number of blanks were presented correlating to the number of responses required. As with the memory test, incorrect responses were flagged if the typed response was incorrect, compensating for misspelling as the original test had an oral response. One other change was made due to the non-oral nature of the test. In the original test, participants could click forward when they were finished reading. The oral nature of the test allowed for a delay between clicks and presentation. In this version of the test it was possible for a participant to click for the next sentence to be presented within a short enough timeframe that the participant would accidentally "skip" a sentence. To compensate for this potential mistake, within one second of the next sentence being presented, the computer would lock-out the participant from clicking to the next presentation.

The full Reading Span Test (van den Noort, et al., 2008) was not used. The original test comprised 100 sentences broken into five "series" containing the various sets of sentences varying in length. It was determined that the complete test would not be

appropriate for this study as the population is not adult and the participants were asked to complete more than one test. The original test in its entirety takes about an hour to complete. It was determined that the use of two series would be large enough for reliability and validity to be maintained, while being short enough to be combined with other cognitive tests and not overly fatiguing the adolescent participants (M. van den Noort, personal communication, April 4, 2011).

Logic Processing Test

The participants were informed that the next test would be a test of logical processing and the parameters for the test. The test began when the participant was presented a logical puzzle. The puzzle followed a format typical of cognitive tests looking at logical processing, The Tower of Hanoi. The Tower of Hanoi puzzle has been used because it has a low reliance on linguistic skill, it has the ability to test the central executive part of working memory and is relatively ease to create and alter into different forms. The basic idea of the Tower of Hanoi puzzle is that a participant is given a board with three pegs. The first peg has a "tower" constructed on it made of concentric rings of diminishing size (usually three to five disks). The participant is asked to replicate the tower on the third peg. On each move, the participant can only move one disk at a time to an adjacent peg. A larger disk cannot be placed on a smaller one. Researchers generally calculate the time needed to complete the task and the amount of moves the participant used in completing the task. This test has been used in a wide variety of situations to test cognitive ability and logical thinking (Hambrik & Engle, 2003) as it is hallmarked to test fluid intelligence (1943), theorized to be the ability to problem-solve irrespective of acquired knowledge.

The test presented was a modified Tower of Hanoi test. The test was modified for an electronic medium. The participants were presented with different colored blocks of differing sizes stacked in the tower formation. Three columns were presented and the participants were asked to use the mouse to slide the blocks to the final column using the rules set forth in a traditional Tower of Hanoi test (Appendix E).

The Tower of Hanoi tests allows for logical reasoning to be tested in a manner that is fairly separated from linguistic aptitude; however, because the directions are verbal, no logical test in a controlled setting can be without a verbal component. While the form of the test has a somewhat verbal/mathematical component to it, the language and mathematics (magnitude of size) are well within the ability of the population to master that it was not be a hindrance.

Data were taken on the amount of moves used by a participant to solve the puzzle and the amount of time taken to complete the puzzle. The ideal solution for the puzzle is 15 moves ($2^n - 1$, where n = the number of disks), and the ideal time is 15 seconds (1 second per move).

Mathematical Reasoning Test

The participant was informed that the following test was a test of mathematical and the parameters for the test. The participants were presented with a number series test in order to determine mathematical reasoning. A number series instrument was selected because it tests inductive thinking more closely associated with "pure" mathematical reasoning than logical reasoning of a mathematical nature (Carroll, 1993). The number series also has a benefit of being more flexible for tailoring a story-line for the play condition than Raven's Progressive Matrices (1962) test.

The particular test presented showed two number series with missing information (see Appendix F) and then asked the participants to fill in the blanks. The first series is governed by the rule that every other number belongs to a certain numerical series and each number is followed by its double. The second series is governed by the rule of alternating addition and subtraction series.

Data were collected relating to both the time required to complete the puzzle and the correctly completed blanks. The participant answered the questions by typing the responses directly into the blanks provided on the screen.

Design of the Play Condition

The play condition is designed to create a fantasy situation for the participants. The game is loosely based on a popular internet game called *SimGirls* b.1.22 (Ecophobia Games, 2002). The original game is a turn-based game where the player can raise personal statistics (intelligence, charisma, etc.), earn money, and participate in mini-games for the purpose of attempting to find a girlfriend. The basis of the game is firmly lodged in the Japanese anime culture and has elements that are inappropriate for the tested population of adolescents (e.g. sexual overtones, language, being able to deal drugs, and the graphics of young girls in short skirts). However, the basic mechanics of the game and general theme of attempting to win the attention of a member of the opposite sex do make a valid premise for a fantasy game to test cognitive skills. The game which was created maintained a similar game mechanic and keep the general theme while modifying the content to be developmentally and culturally appropriate for the participants. The headmasters of each of the participating schools reviewed the game before implementation to ensure the appropriateness of the content for their students.

Overview Description of the Game

The participants taking part in the play condition moved from the introductory screen taking basic demographic information into the game condition. In the first three screens of the game, the participants entered personal information, not being asked in the demographic information part of the study to customize a character. The screens asked the participants to customize their own player in the game by picking a particular personality type, allocating statistics, and rendering a graphic for their characters (Appendix G). The final part of the initial stages of the game had the participants pick a person they wished to be the object of their affection.

The next screens of the game presented the basic plot of the fantasy game. The plot is centered around the adolescent participant's parents leaving the country for a month. The participants were then told that this would be a perfect opportunity to throw a party to gain the attention of the object of their affections. The game allowed twenty "days" of game time in order to create and execute the party.

The participants were then brought to a series of screens giving the background story to the game and a brief introduction to the mechanics of how the game worked. The next series of screens presented a small tutorial as to how the mechanics work and taught them how to play the game successfully. Gee (2003) has noted that successful games work on the concept of increasing complexity. Games that do not have a tutorial that gradually and naturally introduces the mechanics diminish the player's experience and hinder play and fantasy in the gaming situation. After the tutorial, the participants then participated in the game and completed the cognitive tests which relate to the theme of the game.

The overall use of a game which involves adolescents throwing a party in the absence of parents and trying to win the affection of another adolescent is culturally relevant to adolescents. Cultural relevance is the key to making a replication of Istomina's (1975) study work (Reese, 1996). The concept of throwing a party while parents are away is a part of the cultural dialogue of adolescents. It can be seen in movies such as: *Risky Business* (Brickman, 1983), *Ten Things I Hate about You* (Junger, 1999), *American Pie* (Weitz & Herz, 1999) and *Mean Girls* (Waters, 2004). It is also part of online dialogue on networking sites such as *Facebook*. The idea of making oneself a suitable mate for a member of the opposite sex during adolescence is a theme that resounds from ancient sources such as *Song of Solomon* (Hartman, 1986) and *The Metamorphoses* (Ovid, 2005), to modern movies and teen books including: *Scott Pilgrim vs. the World* (Wright, 2010), *Youth in Revolt* (Arteta, 2009), *Summer Boys* (Abbott, 2003), and *The Sisterhood of the Traveling Pants* (Brashares, 2005).

Because of the specific culture of the adolescents involved, the game itself was benign in nature. References to sex, drugs, violence, and alcohol were not present in the game. The graphics of the game were based in an anime-style due to the recent popularity of anime with the adolescent culture (Chandler-Olcott & Mahar, 2003). References to local stores and locations were made as well. All of these details served to create a deeper fantasy situation and personal connections to the game.

Mechanics of the Game

The game opened with a series of screens that allow the participants to personalize the external graphics of the game as well as their personal statistics. Each participant started with 10 points placed in three statistics: Charm, Wit, and Looks. They

were allowed 10 points to spend in each of these domains as they wish. How the statistics are generated determined the strategy that the participants had to employ to complete the game successfully.

The participants selected an object of affection to attempt to win in the process of the game consisting of three male and three female adolescents. Each of these characters had a biography and personal picture (Appendix H). Each character also had a set criterion to win the game using that particular character. The game was calculated out of a 100 point scale that must be accomplished for a particular character/target (e.g. 50% on specific personal stat, 25% on overall party points, 25% on specific aspect of the party points). The participants were never informed of the actual point values that were needed to get the best outcome, but the game did allude to what the specific object of affection likes in a potential mate and party.

The game itself was a point-based, turn-taking-style game. Each "round" of the game was a single "day." The participants had 20 "days" of in-game time before the end-party occurred and the results of the game were tabulated. As each round started, the participants were given a set amount of hours to spend doing certain actions. These actions had different consequences, such as increasing personal statistics, earning money to be spent on the party, spending money to increase particular aspects of the end-party. Some of the actions did not cost points, but spent earned money. The player navigated the game through the use of an interactive map (see Appendix I) and followed a set game structure (see Appendix J).

At set intervals during the game, the cognitive tests were presented. The cognitive tests are the same as those presented in the work condition with minor

alterations to make the context of the game make sense. The games were presented as an element of the overall game, and successful completion of the cognitive tests resulted in a better game outcome.

At the end of the game, the participants followed a sequence to show the party and the relative success in attracting their objects of affection. The end results were calculated by looking at the various factors in the game and by calculating a percentage of success. Depending on the percentage, a different result occurred for the player. Participants who scored 90% and above were rewarded with an innocuous kiss and the phone-number of their object of affection. Participants who score lower had less successful outcomes, such as a text message from their object of affection or being "busted" by their parents.

Once the game was finished, as in the work condition, the participants were asked a series of questions, based on Gray (2009), to determine if their participation actually created a play situation that employed fantasy. A series of questions to examine the qualitative nature of the experience were asked.

Cognitive Tests within the Game

The tests were presented as endogenous to the game. While Oyen and Bebko (1996) found that children performed better on memory tests when the tests were extragenous from the play condition, there is merit to presenting the tests as a part of the game. A reason for Oyen and Bebko's findings may be that the game being played was over-stimulating to the children and that the test helped de-stimulate them, a result shown in Manuilenko's (1975) Spider and Flies study. Another difference is that performance

on the test affects the outcome of the game. In the Oyen and Bebek's (1996) study, no failure was attached to low performance (i.e. the play condition had no goal).

The tests were introduced at regular intervals (Days 6, 9, 12, 15 of the game). Each test was presented with a storyline that related to the overall story of the game. The actual tests were presented similarly to the work condition. Minor differences in presentation, depending on the exact test, created a more seamless context. The presentation of the tests was embedded into the overall story of the game.

The memory test was presented as the participants' best friend having found an ultimate recipe for dip. However, the cell-phone reception is weak and the participants were only able to "hear" the list once before entering the store (twice if requested-"Can you hear me now?"). The delay was presented as the time it takes to get into the store and telling the clerk what is needed. The reading test was presented as the older sister of the participant's best friend being home from college. The best friend's sister states she will come to the party and bring some college friends, if the participant helps her with a psychology project by completing the Reading Span Test. The logical reasoning test is presented as a meeting with a local disc jockey. The participants are asked to impress the disc jockey, who will perform for free, but only for someone who knows how to create a good play list following certain rules. The last test, the mathematical reasoning test, was presented as a trip to a local copy shop with money received by the participants' best friend during Confirmation. The participants attempted to fill in the blanks created by a dirty shop price sheet.

Pilot Procedures

Expert Panel

The treatment and control programs were evaluated by several experts in the field to determine if the programs were appropriate and tested what was being asked. The expert panel consisted of a play theorist, a veteran teacher, a curriculum expert, and a psychological researcher. The feedback from the panel members informed changes to the program before implementation. Some of the changes were semantic in nature (e.g. making the wording appropriate for an adolescent population) and others were related to contextual learning (e.g. making the test and play conditions more disparate). Other changes included the length of the Reading Span Test used and the methods for inputting data.

Piloting

The programs were piloted twice. The first set of piloting was given to a group of adolescents which had similar characteristics as the test participants ($N = 6$). From the initial piloting, the feedback given indicated that the wording was appropriate and the game condition was engaging and socially relevant. It was found during the initial pilot that the Reading Span Test had a flaw. With the initial use of a single series, it was probable that a ceiling effect would occur. After this initial piloting and discussion with the expert panel member whose specialty was psychological testing, it was decided to include two series rather than one (M. van den Noort, personal communication, April 4, 2011).

The second piloting occurred at the participating girls' high school. Due to a programming error, the data collected from that site were not usable for the final data

analysis. Instead, the data were used as a pilot study. An examination of the data received from the pilot study caused another change to be made to the Reading Span Test. Between the initial piloting and the changes made resulting from the expert panel, an error occurred in the Reading Span Test. The error was the accidental deletion of a key direction indicating that the participants were to give only the last word of the sentences. The pilot participants attempted to respond with complete sentences. Corrections were made before the other groups contacted the programs.

Data Analysis Methods

General Data Collection Methods

The data produced from the treatment groups were collected through an electronic medium. As the participants generated the data, they were transferred via a secure internet connection to a secure, private server. Once the data had been transferred to the server, the set was transferred to a secure server without an internet connection, and the original data on the server were destroyed. A single extra-copy of the data was made and stored on a separate, non-internet connected computer.

The data were then examined to clear any issues with misreporting (e.g. misspellings on the memory test) and corrected. The quantitative data set was then downloaded into Microsoft Excel. From there, the data were imported into SPSS for analysis. The qualitative data were not robust enough for formal analysis.

The study was conducted with all of the participants within a short time period. The testing occurred between November 28 to December 5, 2010. The first group to participate was the girls' high school on November 28. The participants (N = 13) were gathered into a computer lab and presented the programs. The second group, the co-

educational middle school, participated on November 30. The participants ($N = 29$) were divided into two groups which were not allowed to interact until the testing was completed. The last group to participate was the boys' high school. The participants ($N = 174$) completed the test over a series of three days (December 1, 2 and 5) due to lab restrictions. The participants were brought to the computer lab through their English classes. In order to decrease the effect of the participants sharing their experiences with each other, the participants were grouped by grade level while participating (e.g. all 10th graders were tested on a single day).

Testing Issues

During the first set of testing (the girls' high school) the testing program froze after the IRB assent screen. Due to communication issues, it took roughly thirty minutes for the testing proctor to communicate the malfunction. Once the malfunction was corrected, the participants only had ten minutes to complete the testing as the headmaster of the school set a time limit for the testing (40 minutes). Because of the early termination of the testing, the data from this set were discarded as a part of the research and were used as pilot data.

The second issue during testing had to do with the middle school testing. The only time allowed for testing was during a half-day on the Wednesday before the Thanksgiving holiday. The data generated from this testing group indicated that a history threat to internal validity existed. These data were discarded as well.

Data Correction and Inclusion Methods

Not all of the data collected from the boys' high school were usable. In order for the information to be useable, it had to be corrected for computer error and decisions about the validity of the data had to be made as well.

The first step of data correction involved the responses on the tests which relied on participant spelling (i.e. short-term memory test and the Reading Span Test). Errors in spelling were corrected according to certain rules. If a participant made a word plural or changed the tense of a verb, the word was counted as correct. Spelling mistakes that created new words (e.g. *most* v. *must*) were counted as errors because it is impossible to determine the intent of the participant. This method is supported by the fact that many of the clear mistakes were made not by synonym replacement, but phonetically similar replacements (e.g. a participant would respond with "parrot" for "parent", but not "guardian" for "parent."). Other spelling mistakes where the intent of the participant was clear, but the word was misspelt, were corrected (e.g. "cancear" for "cancer") while spelling mistakes where the intent was not clear were marked as incorrect (e.g. "kencar" for "cancer.>").

The second step in the correction of data was how to account for missing answers for the Reading Span Test. The program presented ten sets of opportunities for the participants to respond. Within each set, a participant could leave a blank if he did not remember an answer. The data from participants in these cases were always taken and blanks were regarded as incorrect responses. A decision had to be made regarding participants who left all the possible responses blank for a given set. It could indicate a lack of memory or a lack of participation. When correcting the data, if the participant

responded to six or more of the sets, the blank sets were considered to be errors caused by lack of memory. If a participant responded to four or fewer potential sets, the data for the entire test were disregarded, as only participating in 40% of the test suggests more of a lack of participation rather than error caused by memory. The 60/40 ratio for determining error versus participation was selected to be as conservative as possible.

Once the data were corrected and met criteria for inclusion, the data were inspected for outliers. For each of the cognitive tests, frequency statistics and histograms were created. The standard deviations of each test were generated and responses that fell outside of three standard deviations from the mean were removed from the dataset. This method was correlated by placing a normal distribution over the frequency histograms for each test for a visual inspection and using predicted z-scores generated by SPSS. In total, seven scores were removed from the total data set. If a participant had a score removed due to being an outlier, the rest of the data generated by that participant were retained. The entire data from the participants were not removed because the rest of the data did not contain outliers, nor does an outlier indicate an issue with participation, such as missing scores might. Outliers in this study were probably due to computer issues (e.g. a "lagged" connection extending a response time) or the nature of the participants being adolescents (e.g. randomly clicking on the logic test rather than making a serious attempt).

In order to calculate the homogeneity of the population, data were created from the responses given by the participants. The first set of generated data was the median income of the participant's households. Since adolescents have a poor ability to report family income, another method was developed to determine the socioeconomic status of

the participant. The participants were given an opportunity to respond with the ZIP code of their main domicile. By using a site which uses the 2010 United States Internal Revenue Service Database, the median income of the ZIP code could be determined. The median income was used as an approximation of the income of the participant's family. Median income was used rather than mean income, as mean incomes have a tendency to be a less accurate measure of a ZIP code region's general characteristics (ZipWho, 2010). The median income was then employed to create income brackets for statistical comparison.

Once the data were corrected, decisions were made about inclusion. The total number of valid participants was $N = 173$. Two data sets were created from the total number of participants for two different purposes. The first set that was created was to determine the homogeneity of the population sampled. In order to do this, all participants who answered the questions related to pertinent demographic information (i.e. zip code, age, race, and general academic performance) were included ($N = 167$).

The second set of data corrected was the reported responses from the testing in either condition. In order to be as conservative as possible, any participant who did not complete the testing in its entirety was removed from the data set. This decision was made because it relates to engagement. In order for an activity to be regarded as play, a participant must be fully engaged (Gray, 2009). While it could be argued that a participant was engaged in play but chose to opt out of a particular mini-game, total removal was preferred as it more thoroughly eliminates the threat to validity. Also, any participants who did not answer demographic questions were removed from the data set as well. The total number of qualifying participants in the data set was $N = 91$.

The original design of the study included a series of ten questions to confirm that participants in the play condition were in fact play. When the final data set was examined, it was found of the 91 qualifying participants, only thirteen actually completed the questions to determine play. Of the thirteen responses, seven of them were linked to those participating in the play condition. Because of the low response rate, the series of questions is not a valid method for this study to determine if the participants were engaged in play. Rather, an examination of the qualitative responses is more fruitful. Again, the response rate was low ($N = 28$ from the total set of $N = 169$). The responses were terse and usually single-word or a few word phrase. Those in the work condition often described it using words like "boring" or "frustrating." One positive remark was made about the work condition. The play condition had mixed results. Some found the game "gay" or "uninteresting;" however, many of the responses from the game condition were positive: "I like spending and making money," "I felt good," or "dissapoint (*sic*) that the party blew." These statements indicate a mixed preference for gaming types, but overall an engagement in the game as play. For example, respondents in the work condition consistently referred to the tests as "tests;" however, the respondents in the game condition referred to the tests solely as "mini-games."

Quantitative Data Analysis Methods

1. To what extent do adolescents perform basic cognitive tasks, specifically memory, reading, logical reasoning, and mathematical reasoning skills, differently during fantasy play situations than in instructional situations?

The measures analyzed for the cognitive tests relating to memory and reading were the total number of correct responses. A ratio of correct versus incorrect was not

examined as none of the previous research used this method for determining performance. Rather, the previous studies used a simple tally of correct responses given. The purpose of the study is to determine the amount of correct responses. A lack of response or an incorrect response are logically the same concept in this type of study.

The measures for the cognitive tests relating to logical reasoning and mathematical reasoning were: if the participant gave a correct response or not and the amount of time it took to come to a correct response.

The data were analyzed using a one-way Analysis of Variance (ANOVA) test and an independent samples t-test. The independent variable was participation in the work or play treatment groups. The dependent variable was performance on each of the cognitive tests: memory, reading, logical reasoning, and mathematical reasoning. Due to having two levels of a single independent variable, it was not possible to conduct a Tukey-Kramer post-hoc test, as the data did not meet the statistical assumptions of the test. Instead, the graphs from the two different conditions clearly demonstrate the direction of the significance. Also, a Cohen's *d* Test for Effect size was conducted to determine the actual impact of the condition beyond statistical significance.

An ANOVA test was the appropriate statistical measure for this research question because the question asks about statistical differences between the average performance of each of the treatment conditions. The ANOVA test allows for differences without creating a higher chance for statistical error which would occur with multiple t-tests (Mitchell & Jolley, 2007). Cohen's *d* Test for Effect Size is also the appropriate test because it allows for effect size testing between two different treatment groups. In order to conduct this test, the standard deviation was pooled to make the comparison. A

Pearson's R was also reported as an alternative, and more conservative, method of predicting power.

The statistical assumptions were met in order to perform the statistical tests. The sample size was large enough ($N = 91$) that homoskedascity is assumed. Each of the groups had a sufficiently large size ($n \leq 54$ in the work condition and $n \leq 33$ in the play condition). All of the samples taken from the participants were independent from each other as well (Mitchell & Jolley, 2007). A Levine's Test for Equal Variances was performed to determine if the dependent measures had equal variances. It was found that the logic test did not have equal variance with the other tests. Therefore, an independent samples t-test was performed to compare the means of this group. The independent samples t-test has the same requirements as an ANOVA test, yet the test can be conducted with a different formula to compensate for unequal variance.

2. Is there a difference in the age group of the adolescent (middle: 14-16; late: 17-19) and how basic cognitive tasks, specifically memory, reading, logical reasoning, and mathematical reasoning skills, are performed during fantasy play situations?

The data collected for the second research question were the same as those collected for the first research question regarding performance on the cognitive tests and the treatment grouping. The second measure obtained for this question was the age group to which the participant belonged. This measure was obtained during the initial stages of the study when the participant is asked to give background information. While the measure was self-reported and open to the possibility of error due to the participant

selecting an incorrect age group, it is unlikely because of a lack of obvious incentive to do so.

The data were analyzed using a 2x2 Factorial Analysis of Variance (ANOVA). The first independent variable being analyzed was participation in the play or work treatment group. The second independent variable analyzed was the age group of the participant. The dependent variable was performance on three different cognitive tests.

A 2x2 Factorial Analysis of Variance was the correct statistical procedure for this research question because it is able to analyze the multiple independent variables. The 2x2 ANOVA test determined if performance is different in each of the conditions for the different age groups. It was also able to detect interactions between the two different independent variables of age-group and play participation, which is exactly what the question asks. Because only two levels of each single independent variable were tested, it was not possible to conduct a Tukey-Kramer post-hoc test comparing test condition and age as the data did not meet the statistical assumptions of the test. Instead, the factorial graphs from the two different conditions clearly demonstrate the nature of the significance.

The statistical assumptions of the ANOVA test for research question number one also apply to this research question. The requirement of a sufficient size was met ($N = 85$). The assumption for each of the subgroups being sufficiently large or having normally distributed responses has been met as well ($n = 31$ for work condition/middle adolescence; $n = 22$ for work condition/late adolescence; $n = 14$ for play condition/middle adolescence; $n = 18$ for play condition/late adolescence). A Levine's

Test for Assumption of Equal Variance was also conducted to confirm the groups had equal variance. Each of the trials was independent.

3. Do adolescents' age, socio-economic status, and overall academic performance predict their cognitive skills in memory, reading, logical reasoning, and mathematical reasoning during fantasy play situations vs. instructional situations, respectively?

The measures collected to answer the third research question were those of the performance on each of the cognitive tests. The demographic measures collected in the research and play conditions were the age-group, socio-economic status, and overall academic performance of the participants.

The data were normalized into percentages. The tests which had a finite optimum score (i.e. memory, math, and the Reading Span Test) were normalized by taking the number of correct responses divided by the highest possible score. Tests which had time as a component were normalized by setting a maximum time possible (i.e. math test = 300 seconds and logic test = 350 seconds) and dividing the time taken by the maximum time possible. The logic test, which had no maximum number of moves allowed, had the maximum number of moves set at 100, and the calculations for the percentage were calculated in the same manner as the tests with a finite score range. One hundred was set as the number of moves because 100 moves captured three standard deviations from the mean score of the test. For tests where a lower score indicates better performance, an inverse of the percentage was created to make the direction of the percentages equal. An overall performance percentage was calculated by taking the sum of the percentages of performance on each of the tests and then creating a grand mean.

In order to determine if a Linear Regression Model of Least Means could be performed, correlations between the selected demographic measures and the results of the tests sorted by treatment condition were created. These correlations were created because regression models depend upon data being correlated in order to determine the value of prediction.

For each of the statistically-significant correlations, the data were analyzed using a Linear Regression Model of Least Squares. The covariate predictors were derived from the variables of age, socio-economic status (average median income of ZIP code), and academic performance (GPA), but only if they significantly correlated with performance on particular cognitive tests. Because of the limited number of predicting variables, Type-I errors did not occur to a degree that they would threaten the validity of the model.

This statistical procedure is appropriate because it is used to predict performance and examine the relative effect of different conditions on phenomena. The question asks about the predicting factors and the effects of those factors, rather than detecting differences in performance as in the other questions.

The statistical assumptions for the Linear Regression were met by the data set. The specification errors were not present as the relationships between the differing variables were linear. Within the context of the research literature, the relevant variables were captured (i.e. age, socio-economic status, and academic performance). Only one relevant variable was excluded (i.e. gender); however, the sampled population was only male, and thus the variable for this test was not relevant or testable.

Due to the stringent procedure of inclusion of participant cases, the assumption of accurate measurement was met.

The assumptions relating to the error term were also met. Each of the cognitive tests had homoskedascity. Unequal variance between the tests is not an issue as each test was regressed independently from each other. The error terms are uncorrelated as well, and the error terms were normally distributed within each test.

Data Analysis of the Qualitative Element

The second set of responses were a series of open-ended questions (see Appendix L) used to determine the quality and the affective mood of the participants in the work or play condition. While not primarily examining the qualitative data, Istomina (1975) and those who replicated her study often contained a qualitative element to their research (Reese, 1996) to determine how the participants were interacting in the conditions. The findings from this aspect of their studies facilitated the researchers' understanding of the results from the quantitative portion of their studies and led to further understanding about the nature of play.

Delimitations

The study has delimitations as to how far the external validity can be applied to other populations. The population studied here is predominately middle and upper-middle class, white, Catholic-Christian, and male, from an urban setting in a mid-Atlantic state. The results of the study are also only applicable to an adolescent population within a European-American school-based culture. The results may not be applied to populations with special needs, as the sample is comprised of adolescents who were developmentally typical.

Institutional Review Board Statement

The proposed study was presented to the Virginia Commonwealth University Institutional Review Board to ensure that the methodology of the study does not violate the personal and human rights of the participants. The IRB approved the study on May 17, 2010 (IRB# HM13633). Before the research was conducted, each of the parents or guardians of the potential participants, having had explained to them the study and the risks involved with participation, was given the option to withhold consent for their children to participate. Assent was obtained from the participants at the time of the study, and they were reminded at that time that participation was voluntary and that the option to quit at any time was available.

CHAPTER 4 RESULTS

The results from the data collected from the study are presented here. The statistical data from each of the research questions are shared. The descriptive statistics relating to each question are presented followed by the results from the inferential statistics.

Research Question One

To what extent do adolescents perform basic cognitive tasks, specifically memory, reading, logical reasoning, and mathematical reasoning skills, differently during fantasy play situations than in instructional situations?

Descriptive Statistics

Before the ANOVA test was conducted to determine differences in the means between the play and the work condition, descriptive statistics were taken to determine the nature of the data. Table 10 shows the results from the cognitive tests in the work condition.

Table 10

Descriptive Statistics of Cognitive Tests in Work Condition

Test	n	M	SD
Memory Test	55	6.75	2.33
Math Test	55	4.09	1.86
Math Time	54	106.26	60.36
Logic Moves	55	32.36	13.89
Logic Time	55	99.44	61.74
Reading Span Test	54	29.70	6.64

Note: N=91. Time is given in seconds to complete the task.

Table 11 shows the results from the cognitive tests in the play condition. From an examination of the table, a noticeable difference in the average performance on several cognitive tests.

Table 11

Descriptive Statistics of Cognitive Tests in Play Condition

Test	n	M	SD
Memory Test	36	8.61	2.18
Math Test	36	3.03	2.21
Math Time	35	101.37	56.73
Logic Moves	33	43.18	21.36
Logic Time	35	141.12	84.13
Reading Span Test	36	32.81	5.31

Note: N=91. Time is given in seconds to complete the task.

Inferential Statistics

Before a one-way factorial analysis could be conducted to determine if the differences between the means were statistically significant, Levine's Test for Homogeneity of Variances was conducted to determine if the data met the statistical assumption of equality of variance (See Table 12).

Table 12

Results of Levine's Test for Homogeneity of Variance on Test Results

Test	Levine Statistic	df	p
Memory	.35	1	.56
Math Score	3.34	1	.07
Math Time	.05	1	.82
Logic Moves	5.02	1	.03*
Logic Time	3.91	1	.05
<u>Reading Span Test</u>	<u>2.92</u>	<u>1</u>	<u>.09</u>

Note: N=91. *Significant at the $p < .05$ level.

The test for variance found that the number of moves taken by participants has an unequal amount of variance to the other groups. Because of the significance of the variation, the data relating to the logic test were removed from the one-way factorial analysis of variance of the other tests. The ANOVA was conducted to determine differences in performance in the differing treatment conditions (See Table 13).

Table 13

Analysis of Variance Comparing Test Condition Performance Results

Source	df	<i>F</i>	<i>p</i>
Memory	1	14.69	.000*
Math Score	1	6.12	.02*
Math Time	1	.146	.70
Logic Time	1	7.32	.01*
Reading Span Score	1	5.51	.02*

Note: N=91. *Significant at the $p < .05$ level.

The findings from the ANOVA test comparing test condition results with play condition results were significant. All tests were completed with an $\alpha = .05$. The memory test had significant differences with a $p = .000$. The descriptive statistics indicate that the differences in means support the hypothesis that adolescent males perform short-term memory tasks better in a play condition than in a work condition.

The math test had significant results when relating to score ($p = .02$), but not relating to the time to complete the task ($p = .70$). The descriptive statistics suggest that in the work condition adolescent males performed better than in the play condition; however, the differences were not statistically significant. These findings reject the null hypothesis that there would be no differences between the conditions, but they do not support the alternative hypothesis that adolescent males would perform better in the play condition.

The logic test had significant results relating to time to complete the task ($p < .01$). The descriptive statistics fail to support the research hypothesis that adolescent males would perform logical tasks better in a play condition than in a work condition.

The participants in the play condition took longer to complete the task than the participants in the work condition.

The Reading Span Test also had significant results with $p = .02$. The statistically significant differences between the conditions and the descriptive statistics confirm the research hypothesis that adolescent males will perform better on working memory tasks in a play condition than in a work condition.

In order to determine the differences in the logic testing, an independent samples t-test was conducted assuming that variances were not equal between the groups ($N = 88$). A significant effect for logic was present, $t(48) = -2.60$, $p < .01$, with the work condition performing better than the play condition.

The logic test had significant results relating to the score ($p < .01$). The descriptive statistics fail to support the research hypothesis that adolescent males will perform logical tasks better in a play condition than a work condition. The participants in the play condition both used more moves to complete the task than the participants in the work condition.

In addition to the ANOVA test, a Cohen's d test for effect size was conducted to determine the impact of the differences in addition to statistical significance. The Cohen's d is presented because it has been demonstrated to give a more realistic representation of actual effect. The Pearson's Correlation Coefficient is also presented because it is a highly conservative representation of actual effect (See Table 14).

Table 14

Results of Cohen's d Test for Effect Size for Cognitive Tests Comparing Test Conditions

Test	Work M	Play M	<i>d</i>	<i>r</i>
Memory	6.75	8.61	.82	.38
Math Test	4.09	3.03	.52	.21
Logic Moves	32.36	43.18	.60	.29
Logic Time	99.44	141.12	.56	.27
RST	29.70	32.81	.52	.25

Note: N=91. Work n=55 and Play n=36. Time is given in seconds.

Research Question Two

Is there a difference in the age group of the adolescent (middle: 14-16; late: 17-19) and how basic cognitive tasks, specifically memory, reading, logical reasoning, and mathematical reasoning skills, are performed during fantasy play situations?

Descriptive Statistics

In order to better understand the 2x2 ANOVA results, descriptive statistics relating to the data relevant to the test are presented. In addition to the tables, graphs were created to make comparisons of means by age and treatment condition. Table 15 and Figure 3 report the difference between age and test condition with performance on the memory test. The difference between the means of the age conditions was not significant.

Table 15

Descriptive Statistics of Memory Test in Work and Play Conditions Factored by Age

Condition	Age Group	n	M	SD
Work	14-16	31	6.39	2.55
	17-19	22	7.32	1.99
Play	14-16	14	7.93	2.59
	17-19	18	9.06	1.89

Note: N=85

Figure 3: Results of Memory Test in Work and Play Conditions Compared by Age

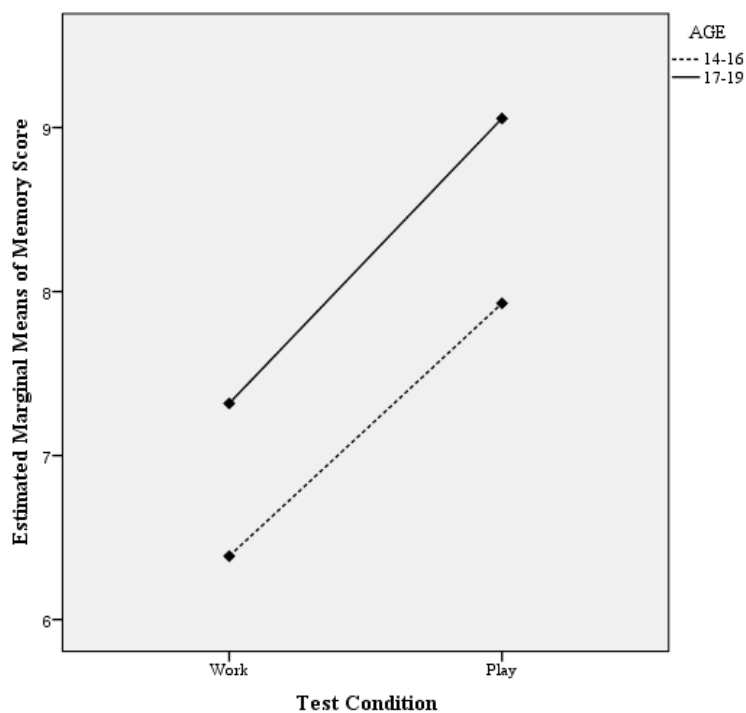


Table 16 and Figure 4 show the differences in performance on the math test. These differences are reported as both in the correctness of responses and in the time taken. In the actual responses, the differences in performance between the two age groups are the smallest of all the cognitive tests. No significant differences in age were present.

Table 16

Descriptive Statistics of Math Test in Work and Play Conditions Factored by Age

Condition	Age Group	n	M	SD
Work	14-16	31	4.10	1.87
	17-19	22	4.18	1.92
Play	14-16	14	2.93	2.57
	17-19	18	3.11	2.06

Note: N=85

Figure 4: Results of Math Test in Work and Play Conditions Compared by Age

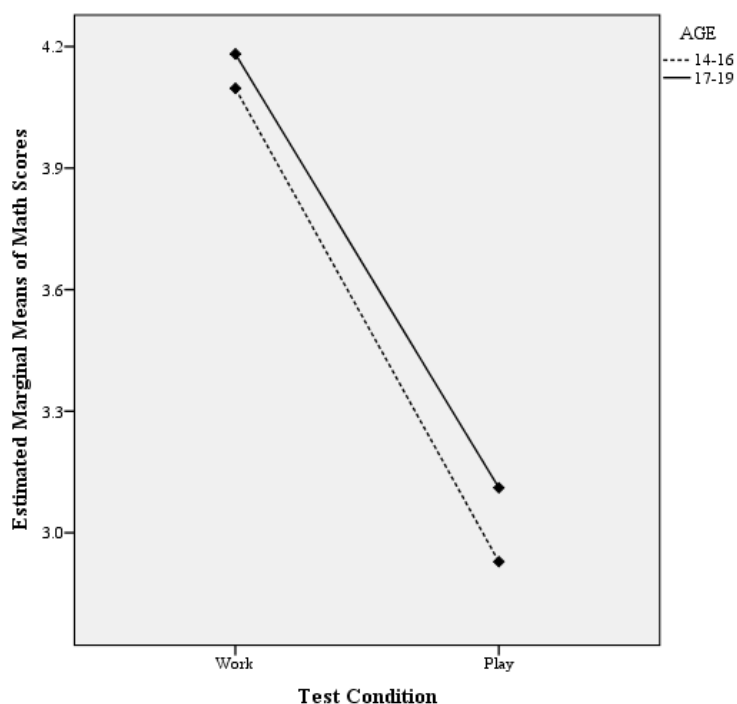


Table 17 and Figure 5 seem to indicate wide differences in age and performance appear to be present. A lower score indicates better performance on measures related to time. The graph clearly shows an interaction which appears at a cursory inspection to be significant.

Table 17

Descriptive Statistics of Math Test Time in Work and Play Conditions Factored by Age

Condition	Age Group	n	M	SD
Work	14-16	31	108.44	58.14
	17-19	22	106.18	64.43
Play	14-16	14	91.32	60.10
	17-19	18	105.12	55.05

Note: N=85. Time is given in seconds.

Figure 5: Time Taken to Complete Math Test in Work and Play Conditions Compared by Age

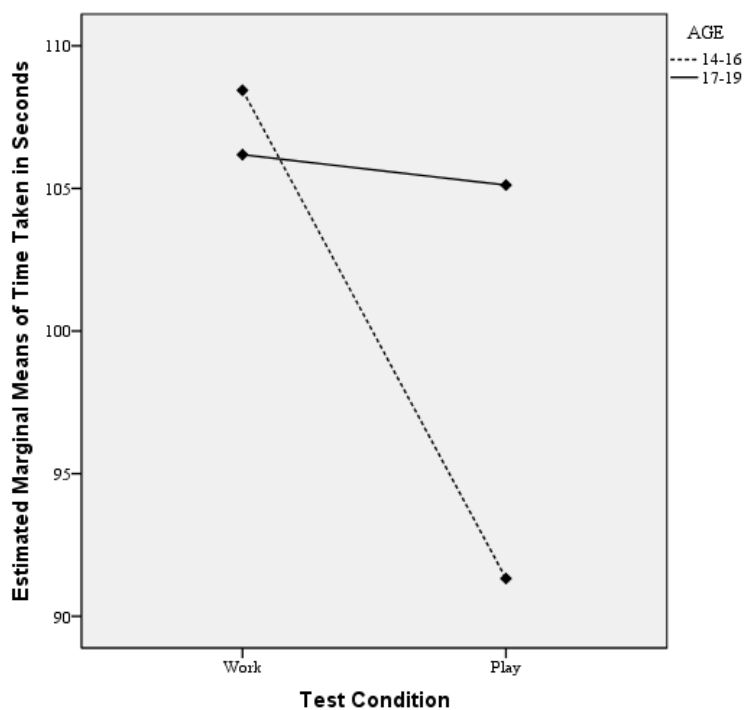


Table 18 and Figure 6 report performance on the logic test in each condition when factored by age. The first table and graph seems to indicate a wide difference in performance based on age and work condition. The graph also indicates an interaction which appears to be significant.

Table 18

Descriptive Statistics of Logic Test in Work and Play Conditions Factored by Age

Condition	Age Group	n	M	SD
Work	14-16	31	31.81	13.11
	17-19	22	34.14	15.33
Play	14-16	14	47.00	19.01
	17-19	18	38.83	22.69

Note: N=85.

Figure 6: Moves Taken to Complete Logic Test in Work and Age Compared by Age

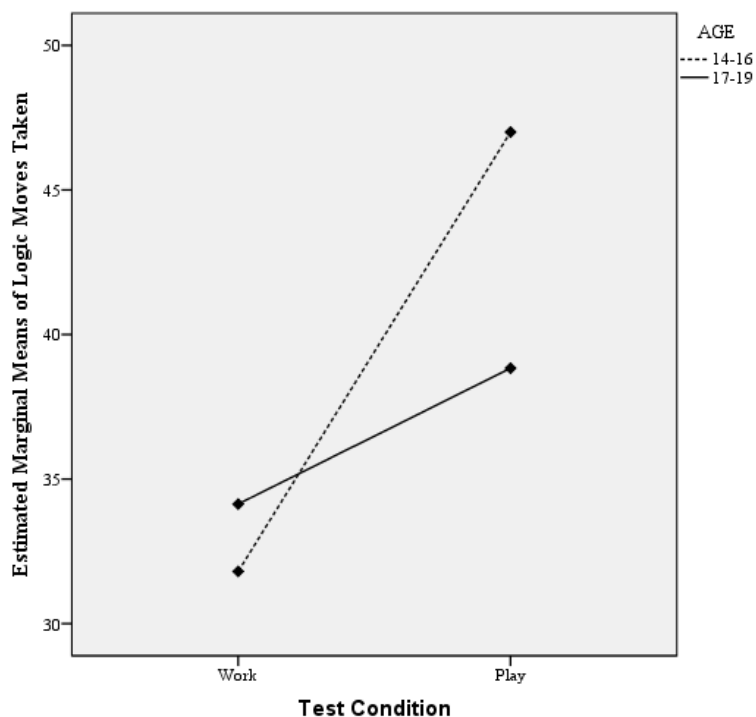


Table 19 and Figure 7 represent the differences in time taken to complete the logic test when factored by age. As with the mathematical reasoning test, a shorter time taken on the test indicates better performance. The graph shows another clear interaction which appears to be significant.

Table 19

Descriptive Statistics of Logic Test Time in Work and Play Conditions Factored by Age

Condition	Age Group	n	M	SD
Work	14-16	31	98.12	54.00
	17-19	22	104.82	73.83
Play	14-16	14	152.76	86.97
	17-19	18	115.78	71.20

Note: N=85. Time given in seconds.

Figure 7: Time Taken to Complete Logic Test in Work and Play Conditions Compared by Age

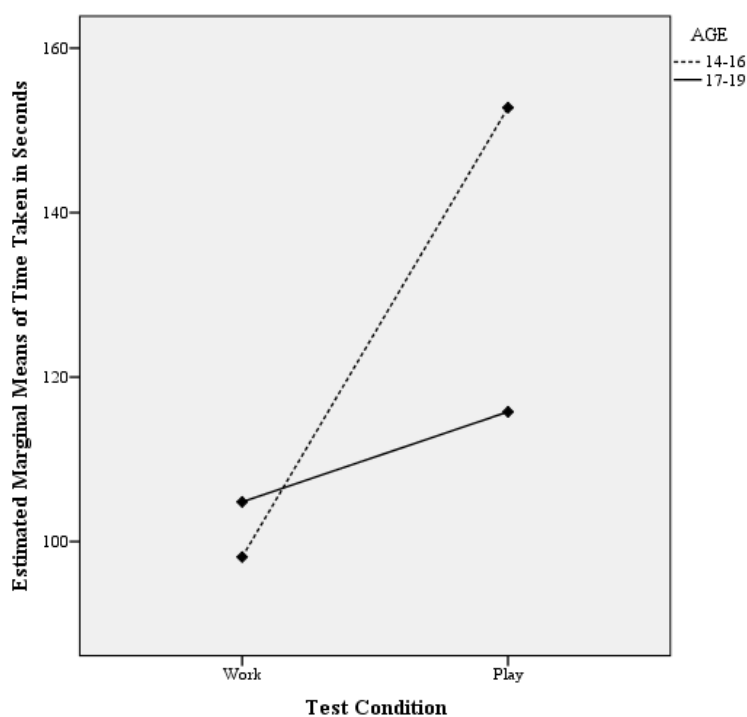


Table 20 and Figure 8 relate to the Reading Span Test. A quick examination of the graph presents no apparently significant interaction, but a fairly weak interaction.

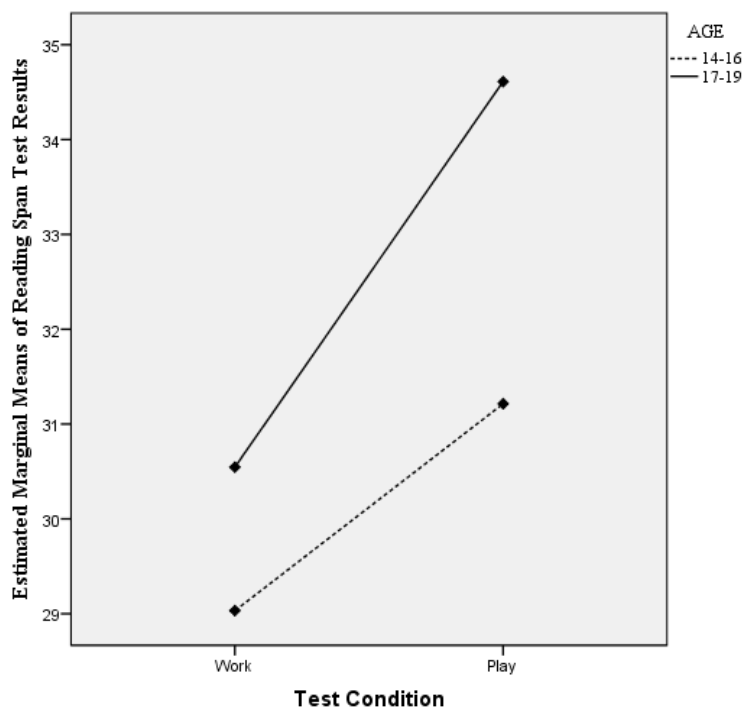
Table 20

Descriptive Statistics of RST in Work and Play Conditions Factored by Age

Condition	Age Group	n	M	SD
Work	14-16	31	29.03	7.03
	17-19	22	30.55	6.25
Play	14-16	14	31.21	7.18
	17-19	18	34.61	3.31

Note: N=85

Figure 8: Results of Reading Span Test in Work and Play Conditions Compared by Age

**Inferential Statistics**

Before an a 2x2 ANOVA test could be conducted to determine if the differences between the means were statistically significant, Levine's Test for Homogeneity of Variances was conducted to determine if the data met the statistical assumption of equality of variance (See Table 21).

Table 21

Results of Levine's Test for Homogeneity of Variance on Test Results

Test	Levine Statistic	<i>p</i>
Memory	1.02	.39
Math Score	2.48	.06
Math Time	.06	.98
Logic Moves	1.45	.23
Logic Time	.95	.42
<u>Reading Span Test</u>	<u>2.73</u>	<u>.051</u>

Note: N=91. * indicates significance with $\alpha = .05$.

The Levine's Test found that none of the groups had statistically different variance, which satisfies the assumption of equal variances for the 2x2 ANOVA.

The final data set after the removal of outliers decreased the size of the participating population for the 2x2 ANOVA. The treatment group that contained the participants of the 14-16 age group and engaged in the play condition went from meeting the statistical assumption of a large enough population size ($n=16$) to being insufficiently large ($n=14$). A series of estimations comparing the expected and observed values was created for each of the cognitive tests and was compared against an expected normalized value to determine normality.

The results from the normality tests indicate that the group of participants in the 14-16 age-group who engaged in the play condition could be included in the 2x2 one-way ANOVA, as the resulting scores were normally distributed.

A 2x2 one-way ANOVA was conducted to determine effects between the age of the participant and performance in the two different test conditions. The 2x2 ANOVA

using an $\alpha=.05$ confirmed the statistically significant findings of the 1x1 ANOVA conducted for the first research question. The results vary slightly due to differences in calculation.

Table 22

Results of 2x2 ANOVA Comparing the Effects of Test Condition

Source	<i>df</i>	F	<i>p</i>
Memory Score	1	9.990	.000*
Math Score	1	5.86	.02*
Math Time	1	.45	.50
Logic Moves	1	6.65	.01*
Logic Time	1	4.41	.04*
RST Score	1	4.89	.03*

Note: N=91. *Significant at the $p < .05$ level.

Table 23 reports the comparison of performance based strictly on age, irrespective of the treatment condition. Within the context of age as a factor, no significant results were produced. The age of the participant—middle- (14-16) or late-adolescence (17-19)—makes no significant differences in performance on the cognitive tests across conditions.

Table 23

Results of 2x2 ANOVA Comparing the Effects of Age Group

Source	<i>df</i>	F	<i>p</i>
Memory Score	1	3.93	.054
Math Score	1	.08	.77
Math Time	1	.18	.67
Logic Moves	1	.57	.45
Logic Time	1	.94	.34
RST Score	1	3.02	.51

Note: N=91.

Table 24 is the cross comparison of the effects of age and the test condition.

Table 24

Results of 2x2 ANOVA Comparing the Effects of Age Group and Test Condition

Source	<i>df</i>	F	<i>p</i>
Memory Score	1	.04	.85
Math Score	1	.01	.92
Math Time	1	.35	.55
Logic Moves	1	1.85	.18
Logic Time	1	1.95	.17
RST Sore	1	.45	.51

Note: N=91.

When test conditions and age were compared, several interactions were present.

Interactions occurred between test condition and age in the performance of the participants on the following cognitive tests: math score, math time, logic score, logic

time, and Reading Span Test (See Figures 4, 5, 6, 7, 8). Even though the majority of the tests demonstrated interactions, none of them was significant. The main effects were significant as they related to the treatment condition, but not age. These findings are consistent with the results of the first research question.

Research Question 3

Do adolescents' age, socio-economic status, and overall academic performance predict their cognitive skills in memory, reading, logical reasoning, and mathematical reasoning during fantasy play situations vs. instructional situations, respectively?

Inferential Statistics for Work Condition

The first step in analyzing the data produced by participants was to determine how the data correlated with the selected independent variables of age, socio-economic status, and academic performance (GPA). The raw data were transformed into percentages for comparison and correlations were created (See Table 25).

Table 25

Correlation of Age, SES, and GPA and Cognitive Performance in the Work Condition

	Memory	Math	Math Time	Logic	Logic Time	RST	Overall
Age							
R	.20	.02	.02	.08	-.08	.12	-.05
Sig.	.15	.87	.90	.56	.56	.41	.71
Income							
R	.18	.33*	-.20	-.13	.126	.11	.10
Sig.	.19	.02	.16	.37	.37	.42	.48
GPA							
R	-.28*	-.38*	-.01	.03	-.03	-.36*	-.09
Sig.	.04	.01	.97	.83	.83	.01	.51

Note: N=53. * Significant at the $p < .05$ level.

Four correlations were found significant: income/math score, GPA/memory score, GPA/math score, and GPA/reading span score. Each of these correlations suggests that each of the independent variables of Income and GPA may be predicting variables for performance on their respective tests. The correlations between GPA and performance were negatively correlated, meaning that the higher a participant's GPA, the lower the performance on the significant cognitive test. A simple regression was completed for each of these significant correlations to determine how much of the overall performance was due to the predicting variable. The results of each individual regression were compiled into an aggregated table (See Table 26). The regressions show that the significant correlations are predictive of a participant's performance.

Table 26

*Model Summaries of Regressions Performed on Significant Correlations in the Work**Condition*

Model	<i>R</i>	<i>R</i> ²	<i>Adjusted R</i> ²	<i>Error Estimate</i>
Income/Math	.33	.11	.09	.30
GPA/Memory	.28	.08	.06	.21
GPA/Math	.38	.14	.13	.29
GPA/RST	.63	.13	.12	.16

The models were then analyzed to determine if the predictor variables were significantly predicting the results on the given tests. As with the models, each test was conducted individually. The results are presented in the aggregated Table 27.

Table 27

*Coefficient Results of Regressions Performed on Significant Correlations in the Work**Condition*

Model	β	St. Error	t	Sig.
Income/Math	5.61	<.01	2.47	.02 [*]
GPA/Memory	-.04	.02	-2.01	.04 [*]
GPA/Math	-.08	.30	-2.92	.01 [*]
GPA/RST	-.04	.02	-2.78	.01 [*]

Note: Significant at the $p < .05$ level.

The regression tests found significant findings with all of the significant correlations where $\alpha = .05$. The findings confirm the research hypothesis that socio-economic status and academic performance are predictors of performance on the cognitive tests related to math scores, short-term memory, and working memory within

the work condition. The predictive value of performance in relation to academic performance is negative, while in relation to income is positive. The findings reject the research hypothesis that age is a predictor of performance in the work condition.

While the results confirmed that socio-economic status and academic performance were negative predictors, the power of the predictors is weak. Socio-economic status only predicts performance on a single test (math). Even then, socio-economic status only explains 11% of the scores. While general academic performance is a stronger negative predictor as it contributes to four cognitive tests, it does not relate to the time taken on the math test nor the time or scores of the logic tests. Even where academic performance is a predictor of performance on the cognitive tests, they do not predict a large amount of the scores. Academic performance explains 8% of memory scores, 14% of math scores, and 13% of working memory.

Inferential Statistics for Play Condition

Correlations were created to determine how the data correlated with the selected independent variables of age, socio-economic status, and academic performance (GPA). The raw data were transformed into percentages for comparison and correlations were created (See Table 28).

Table 28

Correlation of Age, SES, and GPA and Cognitive Performance in the Play Condition

	Memory	Math	Math Time	Logic	Logic Time	RST	Overall
Age							
R	.25	.04	-.12	-.19	.19	.31	.23
Sig.	.17	.82	.50	.29	.29	.09	.20
Income							
R	-.19	.30	.01	.04	-.04	-.18	.13
Sig.	.31	.09	.60	.85	.85	.32	.48
GPA							
R	-.05	-.52*	-.08	.12	-.12	-.03	-.16
Sig.	.77	<.01	.68	.51	.51	.88	.39

Note: N=32. *Significant at the $p < .05$ level.

Only one of the correlations in the play condition were significant. GPA and performance on the math test are significantly, but negatively, correlated within the play condition. In order to determine the nature of the correlation and if academic performance can be used as a predictor of performance on the math test in the play condition, a simple regression was performed on the single significant correlation.

GPA significantly predicted math scores in the play condition: $\beta = -.15$, $t(30) = -3.34$, $p < .01$. GPA also explained a significant proportion of variance in math scores, $R^2 = .27$, $F(31) = 11.16$, $p < .01$. The negative relationship indicates a GPA will result in a lower performance on math scores in the play condition.

The results from the correlation and regression disprove the hypothesis that age and socio-economic status are predictors of performance in the play condition. Academic

performance is a predictor of performance on the math test in the play condition, but negatively. Even though academic performance is a predictor of performance, the null hypothesis is still valid as academic performance does not predict performance on the majority of the tests. Academic performance predicts 27% of the results of the math scores.

Qualitative Element

The responses to the second set of questions were short in nature, either being a single word or phrase. Due to the limited data from the questions, an analysis of the qualitative element was inappropriate. Instead the collected qualitative data were used to help 'color' interpretations of the statistical findings.

CHAPTER 5 DISCUSSION

Links will be made in this discussion between the research literature and the findings. Once the results of the research questions have been illuminated, a discussion of how these findings can affect practice, both in the understanding of developmental psychology and curriculum and instruction for adolescents will be presented. Next, the methodological limitations of the current study will be discussed to define the external validity of the findings and help guide future research. Following this discussion, the philosophical limitations of the study will be presented, as the epistemology used in the creation of the study can affect its external validity. Finally, recommendations for future research projects building upon the findings of this study will be explored.

Research Questions

Research Question One

To what extent do adolescents perform basic cognitive tasks, specifically memory, reading, logical reasoning, and mathematical reasoning skills, differently during fantasy play situations than in instructional situations?

The hypothesis was made that adolescents will perform the basic cognitive task of memory better in fantasy play situations than they will in instructional sessions, specifically in regards to memory, reading, logical reasoning, and mathematical reasoning skills.

The data support the hypothesis that adolescent males perform better while playing when completing memory and reading tasks ($p = .000$ and $p = .02$), but they reject the hypothesis on the other tests because adolescents do better in the work condition when completing logical ($p = .01$ and $p = .01$) and mathematical reasoning

tests ($p = .02$) with no difference in the time taken in either condition for completing the math test.

The *Cohen's D* test found the effect sizes of the differences between work and play indicate a substantial practical significance. Statistical significance only offers the insight that the differences between the work and play conditions are due to something other than chance. Between the two groups, the effect size on all of the tests which indicated significance, demonstrates that the treatment conditions had a substantial effect. The large effect sizes point to the importance of play in the role of cognition of adolescents.

It is more logical that either adolescents would perform better on all of the tests in either condition rather than in select cognitive tests. Several reasons for this disparity may exist. Understanding the causes of the differences will allow a summative perspective to be generated.

The first reason for the differences in the scores may be the result of the variance in the length of time required for a participant to complete the play test condition. The average time for completing the work condition was fifty-six minutes, while the average time for completing the play condition was seventy-three minutes. The tests were presented in the same order for both conditions. The logical and mathematical reasoning tests were the last two tests presented. The additional twenty minutes to complete the treatment condition may have created a fatigue in the participants of the play condition.

This explanation is further supported by no detection of statistical differences in the time taken on the mathematical reasoning test. The mathematical reasoning test was the last test to be presented. The fact that both groups took no significantly different

amounts of time to complete the test suggests that they were attempting the test with similar care. The effects of fatigue at this stage of testing in the play condition may have diminished the ability of the participants. Also, the literature into the cognitive processing of young adults has found that the frontal lobe does not assume its full processing power until the mid-twenties (Sousa, 2005). If this is true, then the Zone of Proximal Development should be most active in the cognitive processes involving mathematical and logical thought. The findings do not support the literature. Fatigue must be interfering with the results.

Another possibility can be explained through Vygotsky's theory (1976). In his seminal article on play, Vygotsky argues that the primary purpose of imaginative play in children is the acquisition of language. A child is denied access to something he wants (e.g. a weapon) and, therefore, he or she uses an object as a representation of his or her want (e.g. a stick). It is by subsuming an object's use through renaming (e.g. "this stick is now a gun") that a child begins to be able to abstract meaning of the names of words from the words themselves. This transition is the beginning of abstract language use and cultural concepts (e.g. justice).

If play is central to the creation of language, it would stand to reason that the parts of the brain that activate language may be intimately connected with the parts which involve play. The two functions of memory and reading comprehension would be the those most closely related to the play areas of the brain. An adolescent or potentially an adult who engages in fantasy play may activate those parts of the brain which are related to language skills. Vygotsky (1931) argued that play was internal fantasy acted out.

This theory ties into Erikson's (1991) and Marcia's (1966) theories about identity formation. It is logical that the development of linguistic and memory ability would still be active within the Zone of Proximal Development during this period of an adolescent's life. The goal of identity formation is for an individual to come to terms with their own personality and the world around him or her. This process would intimately involve verbal ability as the process would involve compromise, sense-making of other people's intents, and cultural competence. All of these skills are intimately involved with verbal ability (Piaget, 1976b; Rogoff, 2003; Vygotsky, 1976, 1978;). Play at this point in an adolescent's life may serve a developmental purpose for identity formation, and, therefore, has a residual effect on cognitive processes which facilitate this development.

Play definitely possesses a role in the cognition of adolescents. The nature of that role is still unclear from the findings of the study. The research literature indicates that cognitive ability by the time of middle and late adolescence should be solidified (Sousa, 2005). If this is true, then there should have been no difference on each of the cognitive tests, regardless of the treatment condition. If it is maintained that cognition is solidified by this age, it would mean that adolescents have different cognitive abilities depending on the situation in which they are currently participating. This interpretation is illogical because it would indicate that universal cognitive abilities are not static. People cannot exceed a cognitive benchmark, solely due to the medium of the test. The alternative hypothesis is that play must still have a developmental purpose in adolescents in order to create the differences in performance. Whether this difference is due to cognition being the primary purpose— or identity formation being the primary purpose

and cognition being a side effect—would require more research to determine the precise nature of the interaction.

Research Question Two

Is there a difference in the age group of the adolescent (middle: 14-16; late: 17-19) and how basic cognitive tasks, specifically memory, reading, logical reasoning, and mathematical reasoning skills, are performed during fantasy play situations?

The hypothesis was made that no differences exist between the play condition than in the work condition in the basic cognitive tasks of memory, reading, logical reasoning, and mathematical reasoning skills between the two tested age groups (14-16 and 17-19).

The findings from the data support the hypothesis. In each of the cognitive tests, there were significant differences as stated with the findings and discussion of question one. When examining differences ($p < .05$) in performance based solely on age and not treatment group, the findings supported the hypothesis (memory score: $p = .054$; math score: $p = .77$; math time: $p = .67$; logic score: $p = .45$; logic time: $p = .34$; RST score: $p = .09$), and the hypothesis is further supported because there were no significant interactions ($p < .05$) between age group and treatment group (memory score: $p = .85$; math score: $p = .92$; math time: $p = .55$; logic score: $p = .18$; logic time: $p = .17$; RST score: $p = .51$).

This result was not entirely unexpected. The current research into cognition postulates that cognition in adolescents begins to set around the age of fourteen (Sousa, 2005). Since this is true, it is not surprising that the two selected age groups (14-16 and 17-19) had no differences in performance.

Because cognition in these two groups is the same, the effect of play on both of these groups should be similar. An examination of the interaction graphs show that in each of the cases, the directional change between work and play was the same for each group on each test, as found in research question one. It is important that the changes went in the same direction because they indicate a similar effect across participant groups. The differences were due to treatment group, but not age.

Research in adolescent development indicates that at a younger age bracket (11-13) cognition, particularly memory, is not as fully developed (Sousa, 2005). Inclusion of this population in the research study might create a statistically significant finding which rejects the null hypothesis that no differences in performance on cognitive tests and age are present. The primary focus of this research question is the existence of the Zone of Proximal Development (Vygotsky, 1976) for adolescents in play.

The purpose of the Zone of Proximal Development is to give a developing child a stepping stone to the next developmental stage. Play has been shown to be a facilitator in this process. Since play is a facilitator to the Zone of Proximal Development, differences in cognitive scores during play activities would be a clear indication that the Zone of Proximal Development is at work in the adolescent. A lack of differences in age and performance demonstrates in this study that, due to age, the participants did not access the Zone of Proximal Development differently. This position about the findings is confirmed by the other research into adolescent development. Since the adolescents participating had already achieved typical development by the time they participated in the study, there would be no differences due to play, as related to age. Instead, these

findings confirm that play, at least in the domains of memory and reading, have an overall effect on performance for the age groups tested.

Research Question Three

Do adolescents' age, socio-economic status, and overall academic performance predict their cognitive skills in memory, reading, logical reasoning, and mathematical reasoning during fantasy play situations vs. instructional situations, respectively?

The hypothesis was made that the factors/variables contributing to (or predicting) adolescents' cognitive skills in memory, reading, logical reasoning, and mathematical reasoning during fantasy play situations versus instructional situations are age, socio-economic status, and overall academic performance respectively.

The findings of the study both support and reject the hypothesis. In the work condition, income predicted math scores ($\beta = 5.61$, $t(51) = 2.47$, $p = .02$); and GPA negatively predicted memory scores ($\beta = -.04$, $t(51) = -2.01$, $p = .04$), math scores ($\beta = -.08$, $t(51) = -2.92$, $p = .01$), and Reading Span Test scores ($\beta = -.04$, $t(51) = -2.78$, $p = .01$). Income also significantly explains variance in math scores ($R^2 = .33$, $F(1, 51) = 6.08$, $p = .02$). Likewise, GPA significantly explains variance in memory scores ($R^2 = .28$, $F(1, 51) = 4.36$, $p = .04$), math scores ($R^2 = .14$, $F(1, 51) = 8.55$, $p = .01$), and Reading Span Test scores ($R^2 = .13$, $F(1, 51) = 7.73$, $p = .01$). The rest of the correlations between the selected factors and tests were not significant in the work condition. In the play condition, only GPA negatively predicted performance on the math test ($\beta = -.15$, $t(30) = -3.34$, $p < .01$) and significantly explains variance in math scores ($R^2 = .27$, $F(31) = 11.16$, $p < .01$) in the play condition. No other factors significantly predicted performance in the play condition.

Income as a predictor for performance on the math scores is congruent with the literature (Similansky, 1990). Socio-economic status has long been acknowledged as a strong predictor of academic performance (Eamon, 2005; Hochschild, 2003; McNeal, 2003). The fact that income did not predict other tests is noteworthy. The research would indicate that income affects overall academic achievement, but the data did not support those findings. In this case, it could be that socio-economic status is more important to achievement in an academic setting, but not to base cognitive skills. Similansky's (1990) research into play and academic achievement gives a second interpretation. In her research, children who engage in fantasy play well have better social skills. These skills would give access and success through the social dimensions of schooling, which would lead to higher academic performance, but not to enhanced cognitive ability. Math in this study may have been affected by socio-economic status because of the population of the school. At the tested school, academics which will prepare for college admissions are stressed. It may be that participants with a higher socio-economic status may choose to engage in extra-curricular activities to supplement these skills (e.g. tutoring for SAT). The other skills would not be affected, as academic tutoring for college admission focuses on reading, writing, and mathematics. The Reading Span Test would probably not be affected, as it tests a cognitive skill which underlies reading comprehension (Barr, Kamil, and Mosenthal, 1996).

The results of the regressions in the work condition which demonstrate the relationship between GPA and performance on the memory, the mathematical reasoning, and the Reading Span tests are not congruent with an expected result. The beta from the

test indicates an inverse relationship. As GPA is lower, a participant's performance is better on the cognitive tests with a significant relationship.

The inverse relationship could be explained by using the theories of fluid and crystallized intelligences (Catell, 1963, 1971, 1987). The theory of fluid versus crystallized knowledge posits that intelligence contains two different elements. Fluid intelligence is the ability to process and cope with new problems and information. Crystallized knowledge is information about previous solutions to problems which is applied to new situations through analogy.

What may have occurred in this study is that when a student has a higher GPA, he "knows" how to solve certain types of problems; however, knowing is at the cost of being fluid. That is why older populations problem solve well with familiar problems, but do poorly with unfamiliar types of problems (Cattell, 1963). As the students learn, new patterns become more difficult. The cognitive tests are a type of problem that students do not often encounter. For example, most mathematical education focuses on how to use equations to solve types of problems, but not on the logic of math (Ben-Zeev, 1996). Therefore, a test of mathematical logic would be an unfamiliar problem. The fact the student is trained in a certain type of mathematical skill (e.g. using equations) suffers in other ways (i.e. being unable to determine mathematical patterns). The development of Raven's Progressive Matrices and similar tests were designed as a method of testing fluid intelligence. The research into mathematics education supports the given interpretation (Carroll, 1993, 1996).

GPA had an negative effect on mathematical reasoning and reading, but not on the other tests. One reason may be the make-up and culture of the school where the

participants attend. The school is a single-sex Catholic military college preparatory high school. Students must complete an academic selection process to get into the school. It would be logical, therefore, that GPA would have an influence on the performance of basic academic skills (math and reading), as the processes involved are the same which would allow the student to attend the school. It is logical that these tests would be more impacted by the negative correlation due to the effects of fluid and crystal intelligence. Logical reasoning is not a cognitive skill which currently holds power as a gateway skill for academic success. Short-term memory has been shown to have little impact on typically developing people in relationship to the skills of math and reading, which are gateway skills.

Income and age did not have a predictive value for scores in the play condition. The reasons for age not being a predictive value are similar to the ones given in the discussion of research question two. The cognitive abilities of the two age groups tested are too similar to have a strong effect (Sousa, 2005).

The first reason that income may not be a strong indicator of performance in the play condition has to do with the homogeneity of the population. Despite variance in the average income for the different participants, the scores are not widely varied. The population does not have many individuals who report belonging to the most upper income bracket nor any individuals who reported being in the poverty category. The range tested is really differing scales of middle-class. The range is not large enough for differences to be readily apparent.

The second reason may be the admissions process to the school because two fundamental types of students attend the school. The first are those who are able to pay

tuition without assistance and the other is comprised of those who attend on scholarship. Those who are able to attend due to scholarship have to have a stronger academic performance in order to stay at the school. The drive to maintain the scholarship presents challenges to do well, which those who pay tuition outright do not have. These challenges could account for why GPA is a stronger negative predictor than income. Intensive study of "correct" responses or methods for deriving a correct response could lead to an intensification of the crystallization of knowledge.

The second part of the third research question examined the predictive power of age, income, and academic performance of cognitive scores in the play condition. The play condition had even fewer predictors of performance than the work condition. The only identified predictor was GPA on the math score. The reasons as to why the predictor variables could not predict performance in the play condition is not entirely clear.

Age fails as a predictor for a similar reason in the play condition as it was in the work condition. Similansky (1990) worked extensively with play and poverty, and her work showed that income should have an impact on the play condition, but in this study it does not. The reason may be with the methods that Similansky (1990) used in her research. Similansky's research was a non-experimental design looking for correlations between the ability to play well and academic performance in the classroom. She was not examining cognitive effects, but, in essence, social skills which lead to high academic performance. An examination of cognitive effects would potentially lead to a differing result. More encouraging is the idea that play possibly has a leveling effect on cognitive performance. This fact would mean that lower-income students in a play situation would

be just as well-equipped as those who are from a more affluent community. Also, Similansky's (1990) work examined comparing children in poverty to those who were not. The population of the current study was more homogenous and the differences may not have been enough to create significant differences.

The inability of GPA to predict most cognitive scores in the play condition may derive from play acting as an equalizer. The relationship between play and the Zone of Proximal Development may have had an effect. If play activates the Zone of Proximal Development, it would mean that participants engaged in play would more readily access the Zone of Proximal Development than those with a higher GPA. Therefore, play would create a more level performance between the two groups, even though both did better in the play condition on the tests of memory and reading. GPA may still have an effect on mathematical reasoning because the Zone of Proximal Development is least closely related to that particular skill. The Zone of Proximal Development has a stronger relationship to verbal processes (Vygotsky, 1978).

Implications for Practice

The findings of this study have an impact in our understanding of adolescent development. The current thinking about adolescent development is that play ceases to have an impact on development at the age of eleven. This position has been posited by both Piaget (1976c) and Vygotsky (1976, 1978). The current research literature has not attempted to test whether or not these assertions are true in the developmental field. Some educational research has been completed to determine if early-adolescent students perform better in play oriented classes, but as yet, not developmental research has been done.

The implication of this study in the field of adolescent development is that play does have a cognitive effect on adolescents. Play is not merely an entertainment in which adolescents engage for pleasure. Because play has a cognitive effect in adolescents that seems to be developmentally driven, more research needs to be conducted to determine the exact nature of play and its impact on adolescent development. Also, if adolescents have a developmental purpose to play, then research for adult play should be conducted as well. The implications for practice in the realm of instruction are much more profound.

Play has the components which may lead to a general emotional state that allows for fuller access to cognitive processes. Gray's (2009) definition of play encompasses these elements: (1) self-chosen and self-directed; (2) intrinsically motivated; (3) structured by mental rules; (4) imaginative; and (5) produced within an active, alert, and non-stressed mental state. These are the same characteristics that can be attributed to how self-actualized people interact with their world and their work. Play itself might not facilitate better cognition, but the elements that compose a play activity do. Work has the potential, in both adolescents and adults, to be play.

The effects of play on cognition in adolescents may be more closely related to motivation than to play itself. Motivation in people is related to relevance. Because of a lack of a developed frontal lobe (Sousa, 2005), it may be harder for adolescents to derive motivation from exerting effort for delayed rewards. Often, the future is used as a motivating factor by instructors for adolescents (e.g. "We are studying this because you will use it in college" or "This review session will help you in next year's class"). Adolescents rely more heavily on the emotional part of the brain, meaning that sustained

effort for a payoff later is not as powerful as immediate results. By making learning relevant, instructors have the ability to tap into motivation. This relevance can come in several methods, such as community involvement, real-life problem solving, or self-exploration, and with nearly infinite ways of tapping into these methods (e.g. a class project to build a garden for a retirement community).

Unlike the other methods of instruction which create relevance, play has the advantage of the utility and versatility. Play-based instruction has the ability to tap into the natural developmental processes of adolescents. Curricula can be tailored not only to increase productivity, but to allow teenagers to engage with identity formation and learning in a way that is not as readily accessible in other forms of relevant instruction. For example, a teenager participating in a program teaching math through building a community garden may do well because of relevancy. But by adding an element of play, the teenager can explore the ideas of what it is like to be a community manager or a community member who benefits from the garden. It can also allow the adolescent to explore different identities in a safe environment.

While being attached to this concept of motivation, play is slightly different. Play can create *immediate relevancy*. Play becomes the object of an adolescent's participation; learning the material becomes secondary. The content becomes the method for success in the curriculum. This form of relevancy is extremely powerful because one of the primary reasons for learning in an adult population is for an immediate purpose (e.g. going to graduate school to earn a degree). People learn because it enables them to do something relevant to them. In the traditional model of adolescent education, an adolescent learns to create a product which usually has no personal relevancy.

Play can have implications for school design programs such as Universal Design and Response to Intervention. Play can have a vital role in these designs since it offers ways to help students who need extra assistance. It can be used both as a remediation device and as a method for preventing negative feelings towards remediation.

Play links positive emotions with learning. Research has found that how a person feels while learning has an impact on how they feel about learning. The current study suggests that memory and reading comprehension (as expressed by the Reading Span Test) are most powerfully affected by play. Play as a method of instruction can create positive feelings towards learning reading which can have lifelong effects on how adolescents (who will become adults) feel about one of the most important doorways to academic and economic success.

Methodological Limitations

Because of the nature of this study, the methodological limitations which affect the internal and external validity are derived from two major sources in the study. The first source is the actual physical methodology used to complete the study. The second source relates to the cultural aspects of the study.

The program used for the study creates the first major limitation to the study. How adolescents engage with video games and programs is still being investigated (Gee, 2003). This study proposed to look at how adolescents processed cognitive information in a play setting. Because the testing was done through a computer programmer and no data were taken by the proctors as to the affective physical responses of the participants, it is impossible to determine if the participants were truly engaged in play.

Data were collected to attempt to determine if the participants were engaged in play or not. However, the adolescents did not engage with this portion of the testing as thoroughly as they did the other portions of the treatment conditions. It was inappropriate to discard all information which did not include the self-reported play element. Few participants completed the questions related to the condition, likely due to the length of time involved in the play condition. Instead, other methods were created to determine if the participant was engaged in play. These methods included looking at engagement time, disengagement rates, and inclusion methods based on completion.

Gray (2009) argues that an essential element of play is the feeling of choice in participation of the activity. The mortality rate of the study suggests that the play condition clearly had this element. Of the 94 participants of the work condition, only 4% chose not to participate and 28% did not complete every test. The play condition comprised of 78 participants. 18% of these participants chose not to participate and 33% did not complete every test. The fact the play condition had a higher rate of attrition could suggest that the participants in the play condition felt more able to disengage or to choose how they interacted with program.

Even looking at the small set of responses from the population, play existed. The respondents in the play condition who did respond to questions about play indicated they were playing. Regardless, due to the nature of the study, it is impossible to determine whether the participants were actually engaged in play.

Another source of limitation to the study had to do with the time element. The participants were tested in a school where class blocks are only forty-five minutes long. The average time needed to complete the work condition is about that amount of time.

The time to complete the play condition is significantly longer, being about sixty-five minutes long. The participants were told they would have as much time as needed to complete the study, including a pass to the next class. Even though this fact was made clear, it is highly probable that the participants felt pressure to rush to complete the study once the "classtime" had elapsed. This fact might contribute to the higher attrition rate in the play condition and the lack of response to the questions at the end of the study. Even though it is not readily apparent in the data, the pressure to finish might have diminished the results of the last two tests (logic and mathematical reasoning).

The differences in the testing conditions and the use of a combined computer laboratory experience is a limitation of the study as well. Because of the disparity of the computer use, some of the participants who took longer to complete the program might have felt pressure by other participants leaving the testing area as they completed the study. As part of the research protocol, the participants were informed that different testing conditions would be used and that participants would leave at different times. Because the participants were adolescents, a pressure for conformity may have affected the results.

Time creates another limitation in the study. The times of the two testing conditions were different. The length of the play condition program may have created a fatigue that did not exist in the work condition. In order to compensate for these effects, the two programs should have had a tighter time variance. The time difference creates issues in drawing conclusions comparing the two conditions, beyond fatigue. A non-uniform time for completion raises the question of engagement time (being given time respites in the play condition) affecting the results.

Another limitation within the methodology were some minor errors within the testing program that did not become apparent until data analysis began. One such error was the use of brackets for responding to age, rather than a response which asked for a specific numerical age. This difference decreased the power of analysis with statistics. It became impossible to examine differences on the ends of the age spectrum of the participants (fourteen and nineteen respectively). The second error was that the program did not take data on the personal statistics of the participants. This information would be vital for determining if play had an identity formation aspect because of the differences between the type of persona that the participant created for his/her game avatar and the participant's real nature. A difference between these two components would indicate evidence of identity formation.

An internal threat to validity may also have occurred due to both researcher effects and diffusion. One of the participants of the study indicated (in the section for which an open response was allowed) that he knew the researcher of the study (i.e. "Hi, Ian."). The researcher of the study has worked with participants of the participating school outside of the school environment as a part of church formation. The participant who indicated he knew the researcher had his data removed from the final analysis; however, the effect may not have been localized, and it is impossible to determine which participants were affected. The fact that the testing was completed over the course of several days allowed the participants to diffuse information about the testing. While precautions were taken to limit this threat, such as having grade-levels take the test at simultaneous times, in a small school, such as the one tested, it would be nearly impossible to eliminate this threat.

Because this study focuses on a highly cultural phenomenon—play—several cultural factors limit this study as well. The first cultural limitation has to do with the population used for testing. The population was sampled because it was relatively homogenous in order to show differences in treatment effects. The downside to this type of sampling is that the external validity of the study is small. The results of this study are only applicable to participants in a similar socio-economic and cultural background.

The second cultural limitation has to do with the presentation of the research materials. Modern America is much more technologically savvy than when the last major studies of this type were created (mid-90s). Adolescents are immersed and engaged in technology in a way that is unparalleled in human history. The advantage of this cultural phenomenon is that the use of a computer program for testing would not cause undue stress or change in performance. The disadvantage is that adolescents now have an expectation of technology that did not exist before. Due to practical and financial concerns, only a certain type of video game could be created for the play condition. These types of games are still fairly popular online, but it is highly possible that the participants did not fully engage with the play condition (e.g. a comment from the open-ended portion: "This is gay."). Games which involve fluid actions and higher resolution graphics certainly would have more appeal to the participating group, but the creation of such a program would have been outside the scope of this study.

The last cultural limitation of this study is the storyline of the game condition. The storyline was created to be as universally appealing to the studied population as possible. A compromise was created because the intended studied population was both male and female adolescents. Males, particularly adolescents, have more specific

interests in video games (Gee, 2003). These video games are usually more violent in nature and have specific game mechanic archetypes. While an adolescent male would certainly enjoy a game about chasing a member of the opposite sex, a more powerfully interesting exercise would have been a game that involved more stereotypical male motifs and comfortable game mechanics (e.g. 1st person shooter).

Philosophical Limitations

How researchers perceive the world and its nature will shape how their research is conducted and interpreted (Paul, 2005). This study was created primarily through a post-positivist theoretical lens with a minor allowance for constructivist principles. The philosophy which informed the research approach created limitations in how the study can be interpreted.

Post-positivism argues for a single truth to the universe, but that that truth in many ways cannot be captured through a single study (Phillips, 2005). Rather, a community of researchers compile and argue about research until a general consensus of meaning is created. This study follows that concept.

Play, engagement, and performance are all static "truths" as far as this study was concerned. A single definition was used for play and engagement was examined through actual yes/no participation. Performance was similarly structured as correct responses, which limit the interpretation of this study. Play is a personal activity, which can only be determined as play by the person engaging in the activity (Bruner, 1976). The study attempted to get at this concept through a series of questions, but the questions were static. How one adolescent interprets the question: " Did you enjoy participating in the program/game?" may vary. What is meant by participation? What is meant by

enjoyment? The study assumes that these words have similar meanings across a group of individuals—a fact which may or may not be true.

Engagement also presents problems in the post-positivist construction of the study. Engagement was determined under a yes/no paradigm, determined by completion of tasks. A participant could have thoroughly engaged in the game element, while choosing not to engage in the cognitive tests presented as mini-games. The opposite could be true as well. Without using a totally different research methodology that employs a different epistemology, it is impossible to determine the nature of engagement.

Finally, performance creates the largest problem for the use of a post-positivist epistemology in the creation of this study. Performance in the study was measured in the correctness of responses. Correctness is not a perfect measurement of performance, but it is one of the few measurements available in the post-positivist approach. It would be valuable to know *how* play affects a participant's method of completing the mini-tests. Play may cause a participant to engage differently, either by being more cautious in order to perform better, or by being less cautious due to having little incentive to succeed. The study attempted to get at this information through a series of open-ended questions, but few participants responded; even fewer responded in a manner that was more than a few words. Even with the series of questions, the presentation and collection of data was post-positivist in nature. In order to determine these qualitative changes, a more constructivist approach would have to be employed, which would have been beyond the scope of this study.

Recommendations for Future Research

This study into play is the first venture into the nature of the development of adolescents as it relates to play. The avenues for different research venues are wide, yet a logical progression of how this future should be conducted is important.

Extensions of the Current Study

The first step would be to replicate this study in order to correct for methodological limitations which impact the clarity of the findings. An initial replication would be with a similar population, but reversing the order of the presentation of the cognitive tests. This replication would clear the issue surrounding the potential for fatigue causing differences in the logical and mathematical reasoning tests. This replication would also decrease the amount of "game" in order to make the testing conditions more equal in requisite completion time.

Age is an important factor to consider with adolescent play. The research literature suggests that the impact on a younger adolescent group would be greater. A second research step would be to replicate the study a second time with a similar population, but expand the range of ages tested. This study attempted such a task, but due to problems with testing conditions, a future research project would have to address the topic.

Gender was not addressed in this research study. As children develop into adolescents, gender creates more significant differences between persons. Another replication of this study including a mirrored female population would provide information as to whether gender is actually a dividing issue with play. As with age, this

study attempted to test the differences, but testing conditions again caused problems with creating viable data. Future research will help close this gap.

Once the gaps have been closed with a similar population, replications of this study with different populations (e.g. minority, public school student, disadvantaged, or disabled) need to be conducted. These replications would have to be theoretical replications. The current study was a theoretical rather than a methodological replication of Istomina's (1975) study and thus prone to similar methodological issues. The game would have to be adjusted to be relevant to the different populations tested. The cognitive tests may have to be adjusted for appropriateness as well. Once a large enough pool of replications has been conducted, the nature of cognitive performance and play can be more solidly affirmed.

Aside from replications of the study, research needs to expand upon the findings of the current study. Research question three failed to identify any factors which would consistently predict an adolescent male's performance in the work or play conditions. The current research paradigm used to create this study, post-positivism, is not particularly generative of new theory. A qualitative research study would need to be developed to help flesh out the factors which can contribute to, and predict, differences in performance in the play condition.

Once this work is completed, the next logical step is to determine if the differences in cognition and play have a contextual factor as well. These research projects would take the research from a theoretical perspective to an applied perspective. The main theme of this research would take the findings of this study and the replications and would transform them into practical applications to be tested. The research projects

would involve taking the findings from cognitive research and play and determining if these effects translate into viable curriculum. The research could then determine the relationship between play, curricula, and achievement in an adolescent population.

The Remaining Gaps

This study was important in identifying cognitive differences between adolescent males who engaged in play versus those who did not. Once the replication research is complete, the next path in understanding adolescents in play is to research, through qualitative methods, what adolescent play looks like. Through these methods, more information can be gathered not just as to how adolescents perform during play, but also to how they perform. These research projects would involve observing adolescents in play situations, both physical and digital, to determine exactly how and why adolescents play. The body of this research strand could potentially generate a new series of replications with a more informed theory, and create a viable adolescent play theory.

Further, the literature suggests there may be other reasons for adolescent play. Marcia (1966) and Erikson's (1991) theories about identity development and how they relate to play should be explored as well. The purpose of the current study was to examine the cognitive aspect of play and development, but a rich body of research could be developed to explore more fully the identity formation aspect of play in adolescents.

There are also social dimensions of play which were not explored here. There is an extensive body of research literature on the effects of play on the social development of children (Hall, 1991; Piaget, 1976b; Similansky, 1990; Vygotsky, 1976). A similar body of research should be explored for an adolescent population. Vygotsky (1976) and Piaget (1976) correlated play with cognitive and social development. Both of these

theorists noted a link in the development of language with the development of social skills through play. It stands to reason that since it has a cognitive relationship to adolescent development, it may possibly have a relationship to the social development of adolescents.

The current study demonstrated the nature of play in a new population—adolescents. New research paradigms could explore play as it relates to development across the entire life-span, not just early-childhood or adolescence. Research is necessary to determine if the effects found in this study carry over into an adult population or if the nature of play in adults is radically different. Research could also be conducted with geriatric population to determine if play serves a developmental purpose in slowing down the effects of cognitive degeneration. Play is not just the "the germinal leaves of all later life" (Froebel, 1887, p. 55), but a lifelong endeavor.

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APPENDECES

Appendix A Institutional Review Board Assent Statement and Questions

Before participating in this research, you need to give assent to participate. You will read about this study and mark that you have read and understood the information. At the end of the information, you will “sign” that you agree to participate by typing your name.

1. This study is about how teenagers think and process information in different contexts.
2. If you chose to participate in this study, you will complete a short computer program that should take between 20-30 minutes. The program will test things like your ability to remember things and figure out logical puzzles.
3. Because of the nature of some of the program, you may feel slightly frustrated by participating. You have the option of skipping tasks if they feel too difficult. □
4. You do not have to participate if you do not want to. At any time during the program, you have the option to quit. No one will blame or criticize you if you drop out.
5. The answers you give will be anonymous. When you participate, you are given an ID number and no one can track your responses. Your specific responses will not be shared with anyone other those who are conducting the research. The results of the study may be shared in speeches and in writing; however, your name and school will never be mentioned directly.
6. If you have questions about the study, you can talk to your teacher or parent before you participate.

I understand my rights in participating in this study and chose to participate.

Appendix B

Demographic Questions

1. What is your first name?
2. What school do you attend (school names removed from this document for confidentiality)?
 - a. School A (co-educational middle)
 - b. School B (single-sex male high school)
 - c. School C (single-sex female high school)
3. How old are you?
 - a. 12-13
 - b. 14-16
 - c. 17-19
4. What is your gender?
 - a. female
 - b. male
5. What would you guess to be the general income of your family?
 - a. less than \$25,000
 - b. \$25,000-\$50,000
 - c. \$50,000-\$50,000
 - d. \$50,000-\$75,000
 - e. Greater than \$75,000
6. What is your ZIP code where you live?

7. What is your average GPA?

- a. 3.5-4.0
- b. 3.0-3.4
- c. 2.5-2.9
- d. 2.0-2.4
- e. 1.9 or less
- f. I do not wish to answer.

7. What is the highest degree your mother earned?

- a. don't know
- b. high school
- c. some college
- d. bachelors
- e. masters
- f. doctorate

8. What is the highest degree your father earned?

- a. don't know
- b. high school
- c. some college
- d. bachelors
- e. masters
- f. doctorate

9. What race, heritage, or ethnicity do you identify yourself with?
- a. Caucasian
 - b. African-American
 - c. Latino
 - d. Asian
 - e. Other

Appendix C
Memory Test Items

- 1. ketchup**
- 2. butter**
- 3. apple**
- 4. honey**
- 5. bacon**
- 6. olive**
- 7. garlic**
- 8. soda**
- 9. jello**
- 10. peanut**
- 11. eggplant**

Appendix D
Reading Span Sample Sentence Group

His parents couldn't understand why he wanted a tattoo on his right shoulder.

The director was very popular, until the employees heard about his affair.

Appendix E
Logic Test Format

Computer 1	I-Pod	Computer 2
Pink- "Perfect": 3:33 Bruno Mars- "Just the Way You Are": 3:40 Enrique Iglesias- "Tonight": 3:52 Lady Gaga- "Born this Way": 4:20		

Appendix F
Mathematical Reasoning Number Series

4	8	6	—	10	—	18	36	—
10	—	17	27	—	34	31	41	—

Appendix G

Character Creation Screen

You have the ability to choose the details of your character.

Name:

Height: feet inches

Weight: pounds

Gender: ☐ Female ☒ Male

◀ Face ▶

◀ Skin Tone ▶

◀ Style ▶

◀ Gender ▶

Best Friend

Name:

Gender: ☐ Female ☐ Male

Choose the basic personality type for your character. Each basic personality type will have strengths and weaknesses associated with it.

☐ Athlete ☐ Hipster ☐ Preppy

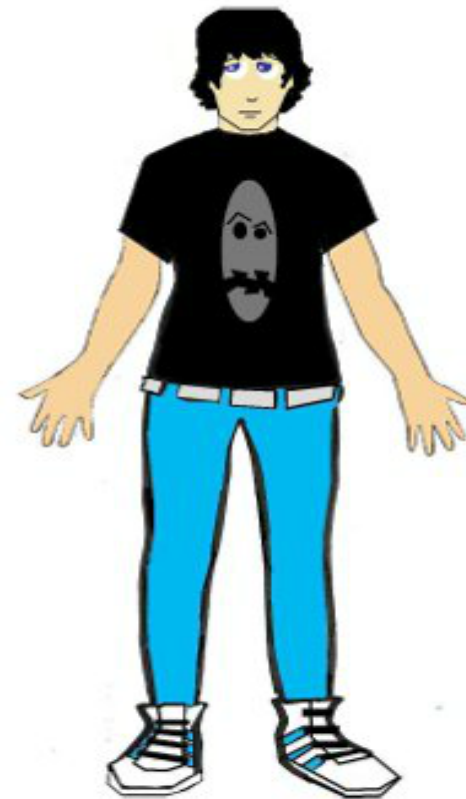
You have points to spend on different aspects of your character.

Points to Spend: 10

Charm: 10

Wit: 10

Looks: 10



Done

Appendix H Character Sample

Your best-friend has decided that at 16 you need love in your life. Eating at lunch in school, he is discussing Petrarch, a Renaissance poet who was deeply in love and wrote about a million sonnets to his crush. The conversation, in your opinion, is unfortunate. You should get over Petrarch.

Name: Jude

Height: 5'7"

Weight: 125

Her Deal:

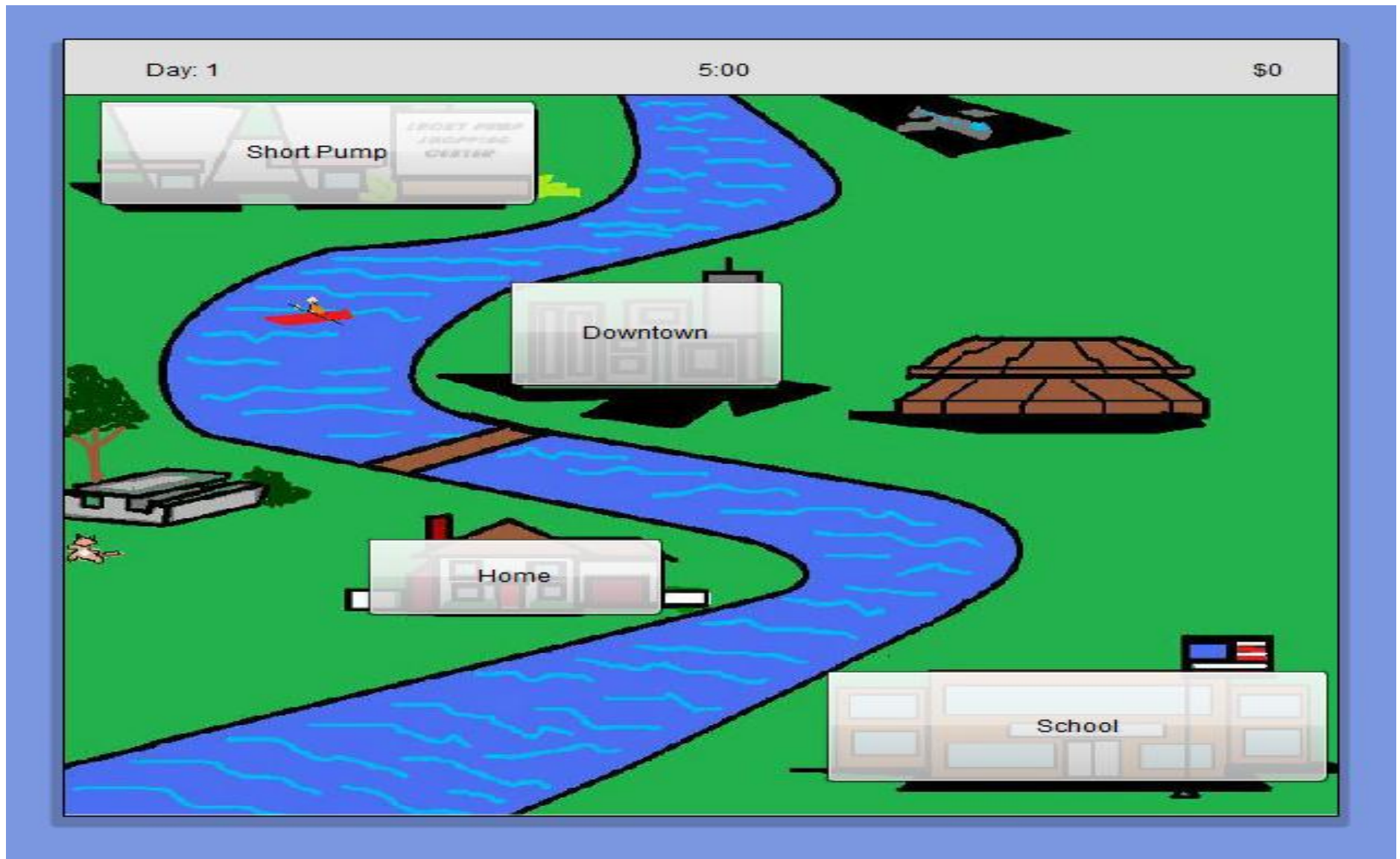
Jude is not typically pretty, but has caught your eye. She is independent and keeps to herself and her close friends, making witty comments about things. Her long black hair and green eyes make her seem much older than she really is. Working on putting together her own band, she has taste and sophistication someone with an appreciation for intelligence and who has to be treated as an equal could really dig.



Close

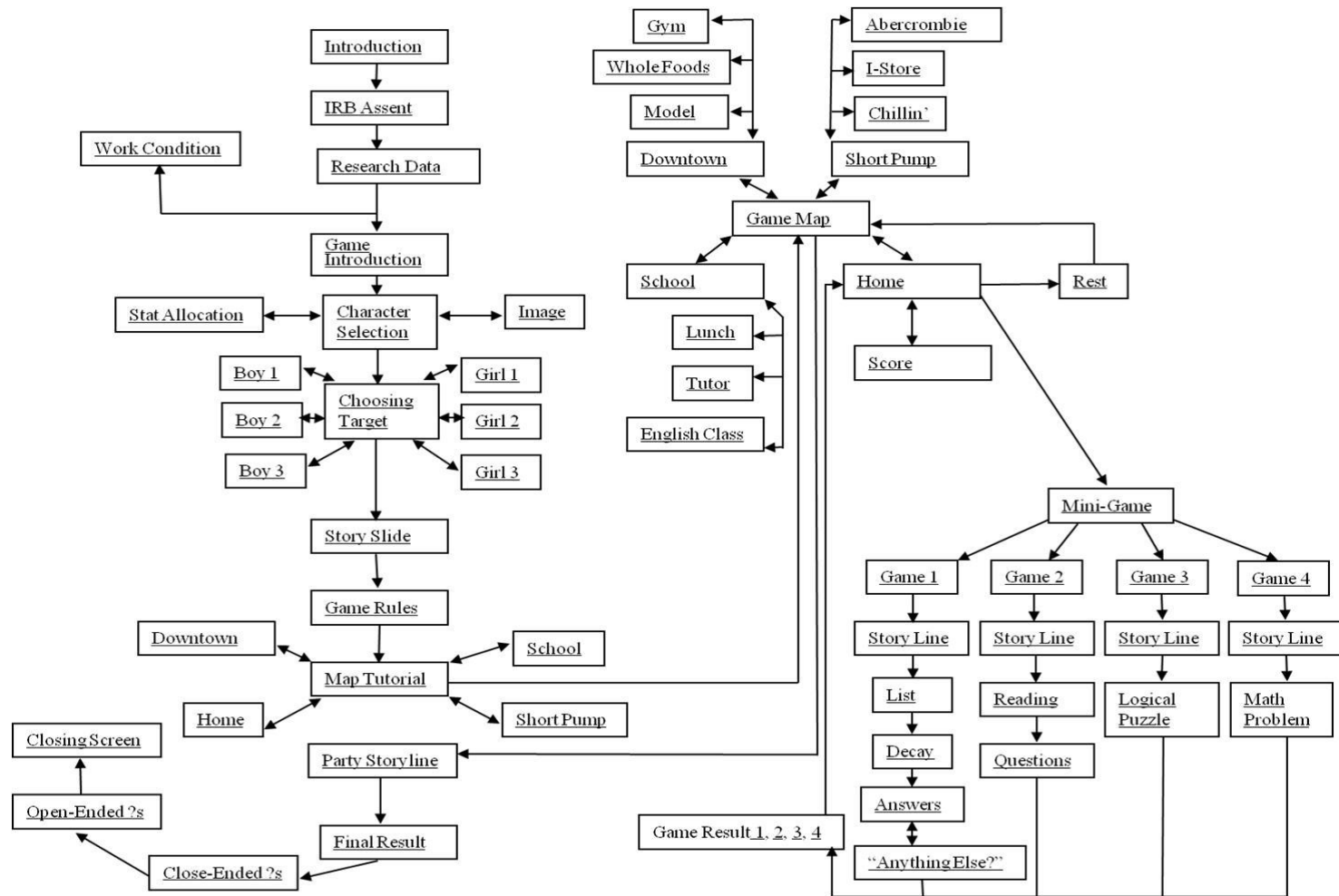
Play Game

Appendix I
Interactive Game Map



Appendix J

Game Structure Flow Chart



Appendix K
Closed Response Questions

1. Did you feel like you had a choice in participating in this program/game?
2. Did you feel that you had control over how you participated in the program/game?
3. Was the program/game motivating?
4. Were you engaged in the program/game?
5. Were you able to follow the rules of the program/game?
6. Did you plan a strategy when participating in the program/game?
7. Were you able to imagine the situations presented in the program/game?
8. Did you enjoy participating in the program/game?
9. Did you feel tired or bored during the program/game?
10. Did you feel stressed during the program/game?

On the sliding scale below, please indicate how "fun" completing this game/program felt.

1 2 3 4 5 6 7 8 9 10

Appendix L
Open Response Questions

1. How did you feel as you completed the program/game?
2. How much did you engage with the program/game as fantasy (e.g. did you picture yourself in the situations presented?)?
3. What kinds of strategies did you use to complete the different tests/mini-games (memory, reading, logic, math)? For example, did you try to repeat the words in the memory test/game to yourself?
4. What did you like best about the program/game?
5. What didn't you like about the program/game?
6. If you could, would you participate in a similar program/game on your own (i.e. would you like to complete/play this program/game again?)? Why or why not?
7. How do you think a similar program/game would work as a way to teach classes?

Vita

Ian Edward Scheu was born on February 1, 1979 in South Hampton, New York and was raised in Key Largo, Florida. He graduated from Coral Shores High School, Tavernier, Florida in 1997. He received his Bachelor of Arts in English from Hampden-Sydney College, Farmville, Virginia in 2000 and subsequently received his Masters of Education in Gifted Education from The University of Virginia, Charlottesville, Virginia in 2002. He taught in the Virginia public school system for eight years and three years at the Faison School for Autism.